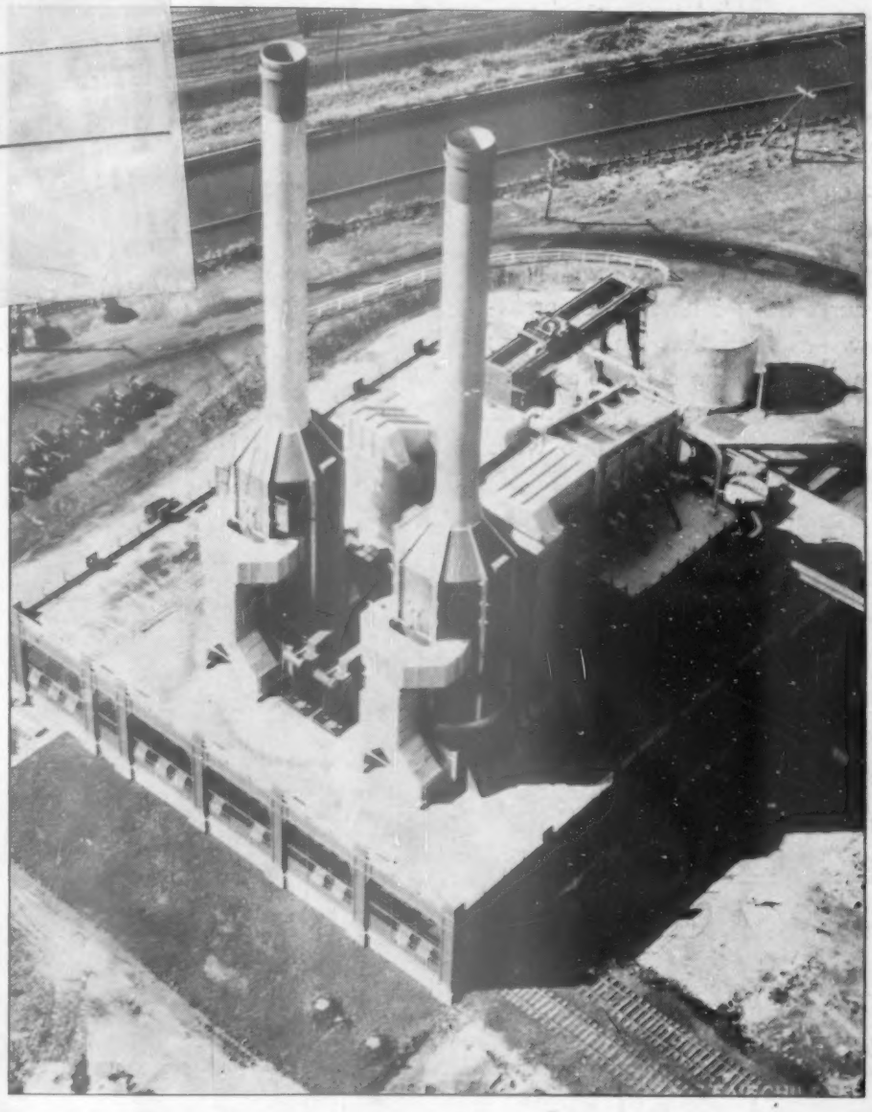
WELDING ENGINEER

February
1934
Vol. XIX No. 2



Pioneer Business and Technical Journal of the Welding Industry

TMENT OF ENGINEERING SHOP

with your comments
and pass on

FROM

BOSTON

CAMPBELL

GWIAZDOWSKI

SPINDLER

E. KRAUS

TELFER

BRENNAN

PARKER

OFFICE

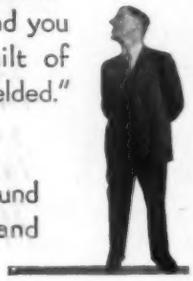
COMMENTS

Form 2860 4-31 2500

(See Pages 15 and 26)

LISTENING IN ON POP AND LAD

"Over there is quite a representative lot of machinery bases, Lad. And you say they're all built of rolled steel arc welded."

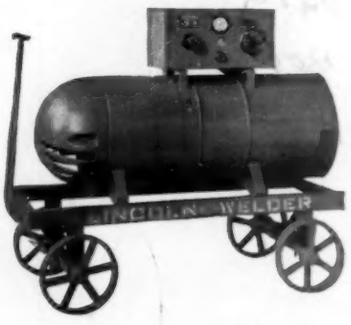


"... which means, Pop, that pound for pound they're stronger and stiffer than cast bases."

"Of course arc-welded rolled steel construction will give all you want in strength and at the same time save weight, but never before did I realize that you can get all these advantages plus pleasing appearance. These arc-welded bases have an eye appeal that helps make sales."

"And they have a cost appeal which will satisfy your Scotch instinct. Your profit-loving nature will demand that the bases you build shall be welded by the shielded arc with Lincoln *'Shield-Arc'* welders and *'Fleetweld'* electrodes. They're guaranteed three ways to give:

1. More weld metal deposit per K. W. H.
2. Faster welding per K. W. H.
3. Lower cost per unit of welding—the unit being per lineal foot of weld, or per pound of weld metal, or per hour of welding."



LINCOLN

THE LINCOLN ELECTRIC COMPANY, CLEVELAND, OHIO

Largest Manufacturers of Arc Welding Equipment in the World

W-62

THE WELDING ENGINEER

LEADING ARTICLES IN THIS ISSUE

FEBRUARY, 1934

Vol. 19, No. 2

Caissons (Page 17)
Caisson Welding on the World's Largest Bridge (Dodge)

Repair (Page 19)
Welding in Plant Rehabilitation (Hettrick)

Oil-Well Drilling (Page 23)
Welding Applied to Oil-Well Drilling (Rogers)

Power Plants (Page 26)
Application of Welding in a Mercury-Steam Power Plant (Rogers)

Editorial—(Page 15)

Ohio Welding Conference—(Page 22)

"Long Tom" Helps to Dismantle Bridge (Calmbach)—(Page 25)

Welding News in Pictures—(Page 29)

Book Reviews—(Page 30)

Get "H.O.T." on Welding—(Page 31)

Much Welding in New Grandstand —(Page 32)

New Equipment—(Page 33)

Trade Literature—(Page 34)

Commercial News—(Page 34)

Notes From the Field—(Page 36)

Published on the 15th of each month by The Welding Engineer Publishing Company, 608 S. Dearborn St., Chicago, Ill. Telephone Webster 7134.

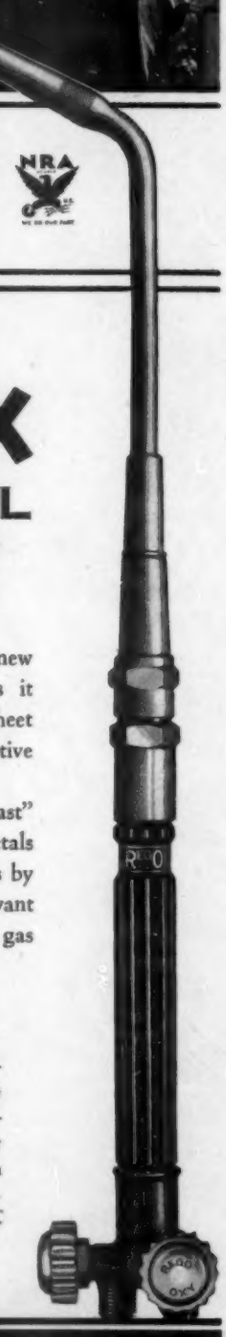
G. H. Mackenzie, *President and Treasurer* K. B. Mackenzie, *Secretary* F. L. Spangler, *Editor*

REPRESENTATIVES

EASTERN: T. E. Depew, 222 American Circle Bldg., New York, N. Y. Tel. Columbus 5-7843.
MIDWESTERN: L. C. Monroe, Room 2264, 608 S. Dearborn St., Chicago, Ill.
PACIFIC COAST: W. R. McIntyre, 1115 Tyler St., Glendale, Calif.

Subscription, payable in advance: United States and possessions, $3 a year; Foreign Countries, $4 a year; Canada, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 30 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

FOREIGN REPRESENTATIVES: GREAT BRITAIN—Capt. D Richardson, 26 Winterbrook Road, Herne Hill, London; AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni, Transvaal, South Africa.



REGO-GX UNIVERSAL TORCH

● It's the exceptional range of the new RegO "G-X" torch which makes it truly Universal. The lightest sheet metals and the heaviest locomotive frames are within its capacity.

RegO "G-X" delivers a long "fast" welding cone bringing the metals quickly to fusion heat with less loss by diffusion. Result—heat where you want it at really worthwhile savings in gas and labor.

Write For the Facts

● You should know about this amazing new torch, development of three years' intensive research. Merely attach this ad to your letter-head for full information without obligation to you. The Bastian-Blessing Company, 242 E. Ontario Street, Chicago.

THE BASTIAN-BLESSING CO.
240 EAST ONTARIO STREET
CHICAGO, ILL.

INDEX TO ADVERTISERS

PAGE

A

Air Reduction Sales Co. 14
American Brass Co., The 35
American Manganese Steel Co. 11
American Steel & Wire Co. 8
Anti-Borax Compound Co. 42
Arcos, Inc. 42

B

Bastian-Blessing Co. 6

C

Central Steel & Wire Co. ..... Inside Rear Cover
Commercial Acetylene Supply Co., Inc. 39

D

Dockson Company, C. H. 42

F

Federal Electric Co. 40
Fibre-Metal Products Co. 39

H

Harnischfeger Corporation 7
Harris Calorific Co. 9, 13, 37
Hobart Bros. ..... Rear Cover

I

Ideal Face Shield Co., The 42

L

Lincoln Electric Co., The ..... Inside Front Cover

M

Metal Bond Manufacturing Co. 42
Milburn Co., The Alexander 42

N

National Carbide Sales Corp. 40

P

Page Steel & Wire Co. 39, 41

R

Revere Copper & Brass, Inc. 16
Roebling, John A., Sons Co. 4

S

Smith & Sons, Inc., David H. 38
Stoody Co. 41

T

Torchweld Equipment Co. 42

U

Under-Water Metal Cutting Corp. 40
Unimetal Co. 40

W

Westinghouse Electric & Mfg. Co. 3

· E D I T O R I A L ·

CONTRIBUTIONS OF WELDING TO THE MODERN POWER PLANT

Those who are accustomed to solving thermodynamic problems with the Mollier chart know the advantages in thermal efficiency obtained in power-plant operation by employing high steam pressures and superheating the steam to high temperatures before passing it through the turbine. Ten years ago, such practice was unusual. To-day, many large power stations, both public utility and industrial-plant, employ superheated high-pressure steam. Pressures up to 400 lb. per sq. in. and temperatures of 750° to 900°F. are not uncommon. Higher pressures have been used in a few instances, even up to the critical pressure of about 3200 lb. per sq. in., at which pressure the transforming of water into steam is accompanied with no change in volume. Metallurgists are giving much attention to the problems involved at these excessive pressures, since the practical limitation of high-pressure, high-temperature power equipment is chiefly one of obtaining materials that will stand up under the conditions imposed. As pressures and temperatures go higher, greater losses result from leakage of steam, unless special precautions are taken to obtain tight joints. ¶Saturated steam at an absolute pressure of 250 lb. per sq. in., which to-day is considered a low operating pressure, leaking through a slit only one inch long and one one-hundredths of an inch wide will result in a loss of 13 lb. of coal per hour. In a plant operating at 400 lb. pressure and 750°F., the loss is 21 lb. of coal per hour, due to a crack of the same dimensions. To compensate for the steam thus lost, each hour 127 lb. of water must be added to the boiler in the former case, and 166 lb. in the latter case. Moreover, each pound of water must be treated with a certain amount of chemicals. It is no wonder that steam power plants are turning to welded joints in place of gaskets and flanges. ¶Moreover, the flanged fitting is a cumbersome, bulky, heavy piece to handle compared with the welding fitting, and can be used in tight places where the flanged fitting won't fit. ¶In addition to its use on steam mains, the application of welding to boilers is too well known to need any mention except in a few particulars. C. S. Turner, of The Detroit Edison Co., has pointed out the advantages of welding hangers and supports that are exposed to the hot furnace gases, as reported in the November, 1933, issue of *The Welding Engineer*. When such equipment is welded to a tube or drum or other cooled part, it does not deteriorate but will last indefinitely, since the heat transfer through the welded joint into the cooler part of the boiler is sufficient to keep the entire piece at a lower temperature than when a clamped or bolted joint is used, which offers a high resistance to heat flow. By welding the soot-blowing elements to the boiler tubes, they are cooled to a safe temperature, even in parts of the boiler that formerly could not be equipped at all with these elements, and the high maintenance cost of these elements has been very much reduced. ¶Welding is playing an important part in the elimination of "caustic embrittlement", characterized by minute cracks in boiler shells and tube sheets near or adjacent to the rivets or the tubes. Caustic embrittlement is most commonly met with in the Great Lakes region and certain other sections of the country. This condition has been the cause of many boiler disasters. But to-day the boiler inspector knows more about caustic embrittlement than he ever did before, and he keeps a close watch for the fine cracks which indicate the presence of this condition. Though the cause and prevention of caustic embrittlement still remain pretty much an enigma, it is definitely established that all cases of this "disease" are found under conditions of high stress of the parts affected and a high alkalinity of the boiler water. The presence of one or more chemicals in certain concentrations tends to prevent the occurrence of this type of embrittlement, even in the case of water containing high concentrations of soda ash used in its treatment. On the whole, high degrees of alkalinity are prevented by "blowing-down" the boiler at intervals, which is standard practice in steam-boiler operation. Nevertheless, the best-caulked seams will often fail to prevent absolutely the entrance of water from the boiler, and the water entering the boiler seams is taken out of the path of circulation, with the result that it evaporates and is continually being replaced by more water, and it becomes only a matter of time until the concentration of soda ash within the seam itself rises to the point where embrittlement of the adjacent shell plate can occur, if at the same time the rivets have produced a state of strain in the plate at that point. Naturally, the elimination of pockets and caulked joints, in which the evaporation of treated water produces a state of high alkalinity, should prevent caustic embrittlement. Since the welding of boiler seams in the fabrication plant gives a continuous, unbroken inner surface to the shell or drum, this is a proper solution to the problem. No welded boiler has ever been condemned for caustic embrittlement, though where tubes are rolled into the tube sheets, embrittlement still might occur in the sheets adjacent to the tubes. Welded boiler repairs do not eliminate the conditions of embrittlement once it has been established. ¶Welding also plays an important part in the mercury-steam power plant, as reported in this issue of *The Welding Engineer*. This type of plant effects high thermal efficiencies without unduly high pressures. The power-plant designer and fabricator will profit from welding in proportion as it is used, and the plant operator will benefit from reduced operating and maintenance costs.

ALL SET!

What KIND *of* ROD *will he use*

This scene is duplicated all over the country. Welder all set . . . ready to go. But what about the welding rod?

A lot depends on rod selection. Nowadays welding shops are turning to Revere Weld-Fast Bronze Welding Rod for the difficult jobs as well as the easy ones.

The reason for this is simple . . . welders have tried Weld-Fast and found it makes money for the shop and customers are satisfied with the finished job.

Five convincing reasons indicate your choice of Weld-Fast Rod: (1) It makes welds stronger than mild steel, (2) has a low melting point (1550° F.) which saves gas and speeds work, (3) makes dense, non-porous welds, (4) machines unusually well, (5) can be laid up in successive layers. The proof is a trial. Remember to

SAY: WELD-FAST
REG. U. S. PAT. OFF.
TO YOUR DISTRIBUTOR

WHEN YOU NEED *WELDING RODS* !

Revere Copper and Brass Incorporated

EXECUTIVE OFFICES: 230 PARK AVENUE, NEW YORK CITY • MILLS: BALTIMORE, MD., CHICAGO, ILL., DETROIT, MICH., ROME, N. Y., TAUNTON, MASS. • SALES OFFICES IN PRINCIPAL CITIES

The Welding Engineer

VOLUME 19 FEBRUARY, 1934 NUMBER 2

Caisson Welding on the World's Largest Bridge . . .

■ By JOHN H. DODGE

Night Superintendent of Welding, Transbay Construction Co.

ONE of the largest engineering projects ever undertaken is the building of a bridge to span San Francisco Bay, linking San Francisco and Oakland. This bridge, which is now under construction, will be approximately 8 miles long and will require four or five years to complete.

An outstanding feature of this huge project is the building of the caissons that will support the massive weight of the structure. In this work, electric-arc welding is playing a prominent part. Welding is used not only because of its lower cost compared with other methods, but also because it will expedite the work in connection with certain features of caisson-building.

In a job of this size, it is imperative that everything "click" in unison, so let's spend a time with the welders engaged in the construction and erection of caisson No. 4, situated in the middle of San Francisco Bay, and learn just what part their "little starlight flashes" play in this big game.

THE welding arc and the cutting torch are indispensable in the erection and sinking of the huge caissons in San Francisco Bay for supporting the suspension spans of the Bay Bridge.

A Welding Crew of 126

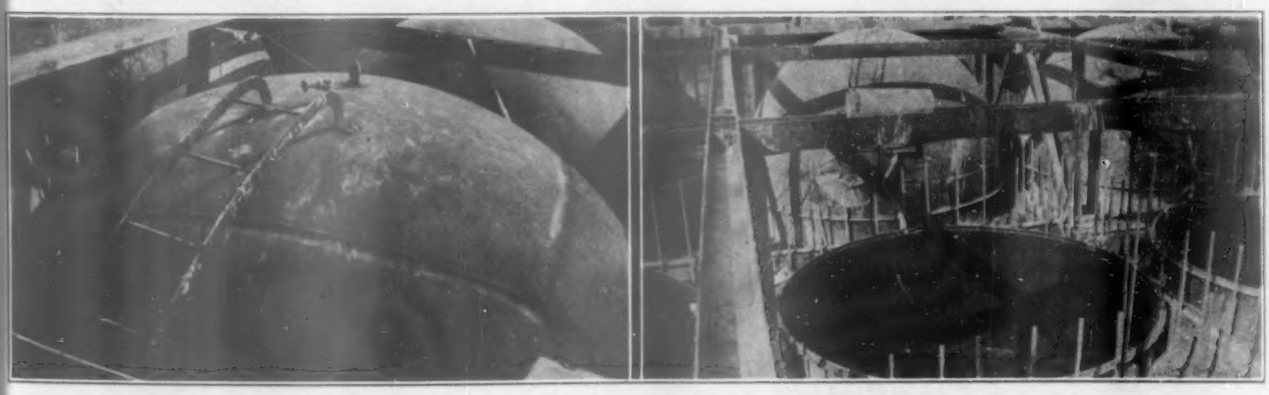
A total of 90 welders, 12 burners, and 24 helpers are employed on this job. These are grouped into six gangs, each gang consisting of 15 welders, 2 burners, and 4 helpers. A gang is "on" 6 hours and "off" 30 hours, giving each man 120 working hours, or twenty 6-hour shifts, in a 30-day month. This is known as a "merry-go-round" and does not confine any gang to continual night or day work.

The caisson is a steel box about 194 ft. square, and built to a height of about 50 ft. when towed into the bay and set in position. Its walls are made water-tight with creosoted boards caulked with oakum and cement. Inside the caisson are 55 cylinders, 15 ft. in diameter, made of 5/16-in. steel plate, fitted in a vertical position similar to a smokestack, and capped with a welded dome of the same material. Each cylinder is reinforced on the outside with circumferential T-irons, ⅜ in. thick, spaced 6 ft. apart. Structural-steel framing surrounds each cylinder, giving the appearance of a modern skyscraper in course of erection.

Caisson Kept Afloat With Air

Between cylinders, the caisson has a steel floor, but the cylinders themselves are without bottoms. The waters from the bay come up to a certain level, acting as a floor, and with a pressure of compressed air varying from 15 to 50 lb. per sq. in. in each cylinder, the caisson is kept afloat.

Concrete is poured around these cylinders, the material being supplied from barges and carried to the mixers by belt conveyors. As the concrete pour rises and the caisson sinks, the outside timber,



The Cylinders Are Capped With Welded Domes, Which Are Lifted Off When Adding New Sections.

structural steel and cylinders must be built higher.

To facilitate sinking of the caisson and to keep it on a level keel, air is released from 6 cylinders at a time, this operation being known as "bleeding." Already 4 oxyacetylene cutting torches, as well as hoses, gages, and tanks, have been installed on two wooden platforms mounted on the structural steel above the domes, enabling any part of the caisson to be reached. Eight single-operator welding machines are nested on one platform and seven on the other. All welding cables are in 50-ft. lengths and equipped with "slip joint" connections. "Feed lines" are hung from the two platforms to the far end of the caisson along the top level, giving eight lines running on one side of the center line domes in one direction and seven on the other side of the center line domes in the opposite direction. Each welding machine is numbered from 1 to 15, the corresponding line is numbered on each post, and each welder is assigned to a certain machine for continual use.

The "feed line" from each welding machine constitutes three 50-ft. lengths of cable—enough to enable the welder to reach any work on that particular level—and an additional 50 ft. is coiled and hung on each post to be used in the event of work having to be done on a lower level.

With this arrangement, welders are easily shifted from one end of the caisson to the other, and they actually have their arcs in operation within three minutes after the "move" is started. The welder merely slips off the leader and electrode holder from the "feed line" and when he has reached his new position he again taps into the "feed line." The pulling of cable is practically eliminated. Ten feet of "ground" cable is dropped from each machine and tack-welded to the nearest I-beam.

Adding Additional Sections to Cylinders

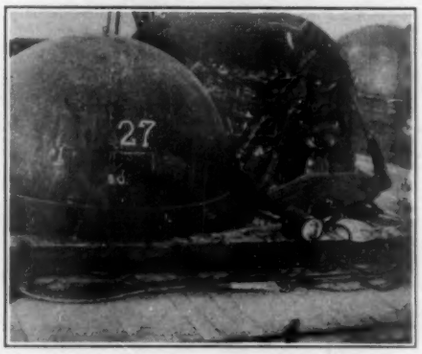
After six of these huge cylinders, scattered throughout the caisson, are "bled" or emptied of air, the locations being determined by the engineering department with a view to sustaining buoyancy, it becomes the welders' job to put on additional sections known as another "lift," thereby increasing the height of the cylinders.

Torches are dropped from above and the cutters sever the domes off the empty cylinders—an operation requiring about 30 minutes and about 47 ft. of circumference cutting for each cylinder. The domes are then lowered onto a storage barge and cranes bring up additional sections of cylinders, which are placed on and welded. Each section is 20 ft. long and is reinforced with T-iron rings similar to the first cylinder sections. A dome is then welded onto each of these six cylinders as before, and the pressure is turned on and the welds examined by state inspectors. In this manner the cylinders are built up a section at a time in groups of six. All the while, the concrete is being poured and the caisson is sinking deeper and deeper into the bay, finally penetrating the mud and silt at the bottom of the bay and coming to rest on bedrock at a depth equal to the height of a 20-story building.

A natural question is, How are the cylinders ever taken out? The answer is, They don't come out. They, too, are filled with concrete and remain embedded in that enormous block until time eternal.

As the structural steel of the caisson is carried higher and higher, the joints are held in position with angle-iron clips and bolts until all joints and intersections have been welded, after which the clips are removed.

The equipment used on this job comprises Hansen and Westinghouse d.c. motor-driven arc welders, rated at 300 amperes. The oxyacetylene apparatus is of Victor make. "Raco" shielded-arc rods are being used, coupons welded with these rods being tested to 80,000 lb. per sq. in. without failure.



Welded Domes on Storage Barge.

All welding operators were required to pass tests on overhead, vertical and flat welding, their eligibility being based on their ability to make specimens having not less than 65,000 lb. per sq. in. tensile strength.

No time is lost in changing shifts, as each operator waits until his relief man appears and, as each gang comes out in the same boat, the change is made in a body. Helpers supply the welders with rods from storage on the welding-machine platforms, adjust the machine heat according to the welder's instructions and prepare any necessary staging in advance to the welder's next move. In this way, the welders keep above the concrete men, and the structural men above the welders.

Over a period of two months, there has been no actual shut-down from any material cause, other than a possible 10-minute delay to change exciter brushes in some of the welding machines. These machines have stood up under continual 24-hour service, with high heats and ¼-in. rods.

Hodge Addresses Welding Section at Cleveland

At the meeting of the Cleveland Section, American Welding Society, held on the evening of Jan. 24th, Dr. J. C. Hodge, who has direct control of welding operations at the plant of The Babcock & Wilcox Co. at Barberton, Ohio, presented a highly interesting paper on "Actual Welding Production, Welding Problems and Welding Control."

Iowa State College Holds Successful Conference

The Sixth Annual Welding Conference held at Ames, Iowa, Jan. 24th to 26th, by the Iowa State College was highly successful both in attendance and in the quality of the program presented. Prof. D. C. Faber was in charge. The registration of 271 represented a new high mark for these conferences.

In addition to the program of the conference as it appeared in the January issue of *The Welding Engineer*, two talks were given on hard-facing, one on "Hard-Facing in the Welding Shop," by Don Llewellyn, of the Air Reduction Sales Co., and the other on "Hard-Surfacing Valves and Valve Seats," by E. F. Smith, of the Haynes Stellite Co.

An innovation was introduced this year in the form of a banquet, which was held on Thursday evening, Jan. 25th, at the Memorial Union. W. L. Allen, of the Allen Machine Shop, Ames, Iowa, made a genial toastmaster, and at one place in the program he exercised his powers of persuasion to good effect. The job-welding-shop code was discussed briefly by Henry Malek, of Cedar Rapids, who urged job-shop owners to organize under the National Association of Welding Contractors. Entertainment included dancing, singing, tumbling and pyramid acts by grammar and high-school girls trained by Jake Daubert, Iowa State College coach.

A total of 103 attended the banquet. By unanimous vote it was decided that the banquet be made an annual affair.

Exhibitors at the conference were: Air Reduction Sales Co., Aladdin Rod & Flux Mfg. Co., The American Brass Co., Balbach Co., The Bastian-Blessing Co., Gasweld Equipment Co., General Electric Co., Gibbs Welding & Supply Co., Haynes Stellite Co., Hobart. Bros. Co., Imperial Brass Mfg. Co., The Lincoln Electric Co., The Linde Air Products Co., Major Engineering Works, Metal Bond Mfg. Co., Metallizing Co. of America, New Process Plow Welding Co., Omaha Welding Co., C. E. Phillips Co., Sight Feed Generator Co., Steel Sales Corp., Stitzell Sales & Service, Torchweld Equipment Co., Westinghouse Electric & Mfg. Co., Wilson Welder & Metals Co.

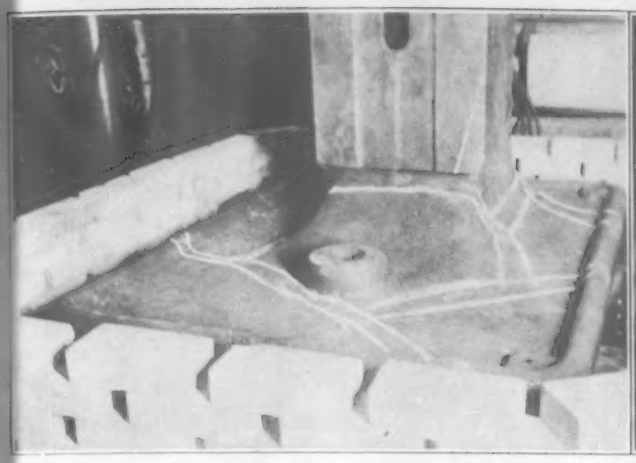


Fig. 1. Base and Lower Part of Machine Column With Fractures Outlined With Chalk.

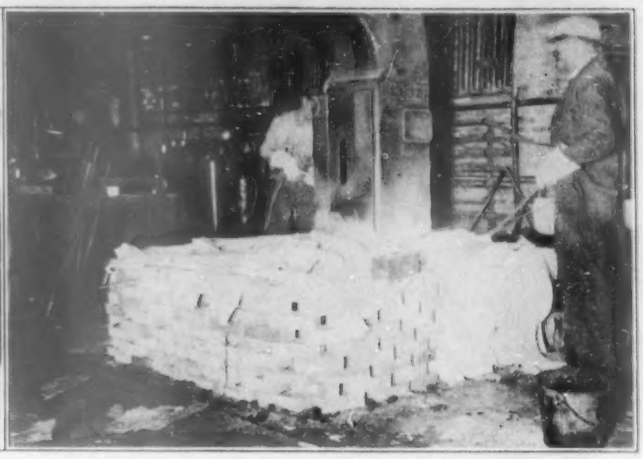


Fig. 2. Preheating and Welding the Column Base.

Welding in Plant Rehabilitation

Paper read before the Welding Conference at Purdue University Lafayette, Ind., Dec. 7-8, 1933.

By GEORGE HETTRICK
President, Anchor Welding Service, Inc.

WHERE welding is employed in plant rehabilitation, its application is almost entirely that of repair. It may be a fractured casting, a broken punch-press frame, a worn shaft, or a discarded part which is reclaimed from the scrap pile and repaired by welding to form an essential part of some machine or piece of equipment in the plant.

Not only is repair welding a money-saver to many industrial plants, but often it is the only way in which equipment can be rehabilitated within a short time.

The individual applications of the welding processes, whether they be gas, arc or thermit, are without number. The economic use of these processes requires a knowledge of: (1) correct technique; (2) physical properties of various metals and their action under the welding heat; (3) economies and practicability of the various processes; (4) equipment required; (5) ability of the plant's welding department, or of the contractor if the work is let out, to do the work properly; and other minor factors.

Failures Make for Skeptical Attitude Toward Welding

Too much emphasis cannot be laid on the need of an understanding of fundamentals in the repairing of equipment by welding. An improper application of welding may result in a failure, which is apt to make the management skeptical of welding in general and to create a situation which shuts the door to the use of the welding processes, thus preventing the economies which such processes effect in time and labor. The layman not familiar with the art of welding loses respect for the process simply because an inexperienced man has made a failure of his particular job, when in reality the individual should be held responsible and not the process.

The job welding shop was the pioneer of the welding industry, but today it is considered as only a small portion of that industry, due principally to the fact that those plants that own welding outfits generally consider themselves capable of handling all classes of welding.

There are also plant managers who have purchased welding equipment with the belief that any ordinary man with average intelligence can learn to handle his welding repairs in a few weeks or months. But if a heavy casting breaks and the repair weld fails welding itself is condemned.

The welding of machinery parts requires a great deal of experience on the part of the job shop owner or the department head, on the one hand, and the man actually doing the work, on the other. The average welder has been trained to certain work: it may be the welding of defective foundry castings or the welding of spouts on coffee pots. In either case this man is of practically no use to a job-shop contractor. A man to be successful in repairs of machinery must have experience in this particular field. He must understand how changes in temperature produce expansion and contraction if he is to preheat a casting properly. He should also have a general knowledge of machinery and its operations.

A fault of the average welder is that he generally does not secure a sound weld at the bottom of the fracture of a heavy section, which is very essential to good welding. In a good many cases, the writer has come across welds with only 3 in. of penetration when the section itself was 6 in. in thickness; this class of work can result in nothing but failure.

Fig. 3. Preheat, Weld and Cool, was the Formula for Repairing this Cast-Iron Base.

Repair Welding Requires Proper Equipment and Facilities

The plant welding department or job shop must have proper facilities for handling repair welding. There should be a space set aside with a brick floor, a high ceiling, and plenty of ventilation, also overhead crane facilities to enable proper handling of any heavy sections.

Practically all heavy cast-iron machinery parts should be preheated before welding. The principal reasons for this are, to take care of strains produced by

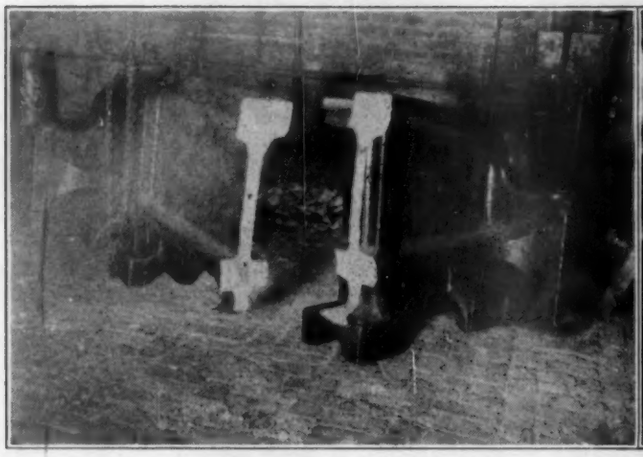


Fig. 4. Break in 8000-Lb. Brake-Press Head.

Fig. 5. Welded and Reinforced, the Head Is as Good as New.

expansion and contraction, eliminate distortion, and secure a sound, machinable weld. Also, preheating of cast iron results in a great saving of oxygen and acetylene. The most successful fuel for preheating is charcoal, due to its slow starting and uniform heat. However, in some cases of small sections, city gas and compressed air, or kerosene blow torches, are used with success.

For a good many years our company has been using a method of tack welding heavy sections in place before preheating. Some of the accompanying photographs show this method clearly. It consists of lining up the casting to be welded; and after both halves have been properly shimmed and the casting has been checked for alignment, the electric arc is then used and tack welds about ½ in. long are placed at 4- or 5-in. centers. Should the break fail to close up tight before tacking, it will be found that as the arc weld cools it draws the two sections together, making it difficult at times even to locate the hair-line crack which remains.

Overheating Produces Failures in Bronze Welding

Bronze welding of cast-iron machinery parts is being used successfully. In applying this method, it is very essential that the weld first be ground or chipped to a vee and that the base materials be free from any grease, oil or scale at the point of welding. At no time should cast-iron at the point of the weld be heated above a dull red heat. Overheating has caused a great many bronze welds to be unsuccessful.

The electric arc also plays a large part in plant rehabilitation. It is used for the welding of various steel castings and the maintenance of plant equipment, such as building up worn shafts, building teeth in steel gears, welding of boiler tubes in stationary boilers or yard cranes, and various other parts.

Alignment is one of the most important problems that a plant or jobbing shop welder has to contend with; it is a problem in which welders show more weakness than in almost any other. We in our organization consider the question of alignment just as important as the ability to thoroughly fuse or to obtain complete penetration. I have seen many jobs in my travels in which the weld was first class, with thorough penetration and plenty of reinforcement, yet the part failed because it was so much out of line that it couldn't possibly function for any length of time. If machine work is necessary due to distortion from welding, this is apt to make the owner discouraged with welding, as it adds greatly to the cost of the job.

Fig. 1 shows the base and lower part of a vertical milling machine column,

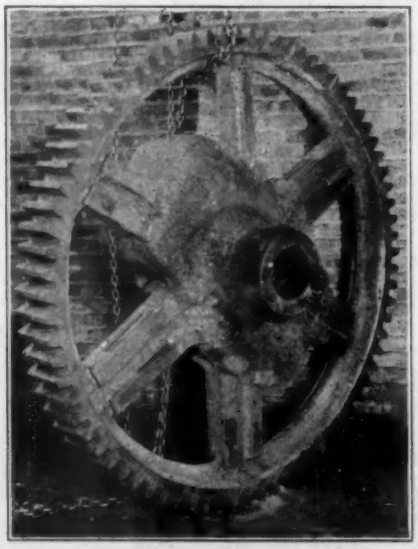


Fig. 6. Two Broken Spokes of This Cast-Steel Gear Were Welded and Then All Spokes Reinforced.

which in being moved from one location to another was dropped about 12 ft., due to a defective cable. When received in the shop, the column was intact and had no breaks, but the base had been broken into as many pieces as are outlined by chalk. It looks as if it might have been one of the original jig-saw puzzles.

The column was first set on piers and the various pieces were fitted into their respective positions and tacked in perfect alignment. Then a preheating furnace of firebrick was built around the job. Fig. 2 shows the job after it was fired with charcoal and the welding started.

Charcoal Makes Ideal Fuel for Preheating

Wherever possible we use charcoal heat because of its evenness and softness. Although many welders will look with scorn on charcoal, I believe I am safe in saying that the welder who thoroughly understands his work and really knows how to handle charcoal will agree with me that it is the ideal fuel for preheating.

We used two torches continuously on this job, and three welders, which allows each welder to be relieved at regular periods.

After the welding was completed we added only enough charcoal to equalize thoroughly the heat in the base, after which the casting was completely covered with asbestos paper and allowed to cool very slowly. The heating of a casting from the cold stage to the welding heat, and likewise the reverse operation reducing it from the welding temperature to the cold stage, are very important.

When cold, the casting was removed from the furnace, ground and dressed with a portable electric grinder and returned to the customer.

The labor and material figures are as follows: Line up and prepare, 6 hours, 2 men; heating time, 6½ hours; approximately 18 ft. of 2½-in. welds; welding time, 17 blowpipe hours, 2 torches, using No. 15 welding heads and 3 welders; weight, 4000 lb.

Fig. 3 shows a radial-drill base which was broken along the area outlined in chalk. This break was due entirely to a faulty foundation. The procedure on this job was quite similar to the preceding one, namely: preheat, weld and cool. The weld was started in the center of the

break and worked to both ends, using two torches. Material figures on this job were as follows: Dimensions, 8x3 ft.; 66 in. of 2-in. welds; weight, approximately 3000 lb.

Cause of Original Breakage Should Be Eliminated

In maintenance welding, merely the welding of the broken part is not always the complete answer. As in this job, the break was caused by a faulty foundation. Just to weld and replace the casting would only be subjecting it to the same conditions which broke it previously, and it would no doubt break again, either alongside the first weld or at the next weakest point. So the foundation should be, and in this case was, put in first-class condition.

There are several reasons that may cause a machine part to break in service,

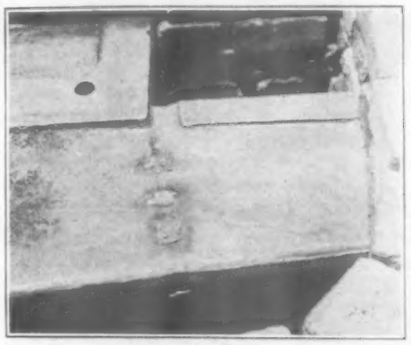


Fig. 7. Broken Cast-Iron Frame with Parts Tacked With the Arc to Draw Them Together.

and we always try to discover the reason which applies in each particular case. We guarantee our welds, but we do not feel that that is enough. We explain to the owner of the particular part or to the plant superintendent that if the cause of the original break is allowed to remain or to happen again, we cannot guarantee that the part will not break again, of course, outside the weld, and we urge him to eliminate the cause if possible. Whenever we can do so, we reinforce a weld

Fig. 8. View of Completed Repair Shown in Fig. 7, With Reinforcing Lugs.

sufficiently so that some other part of the machine will be the weakest link and not the weld.

A metal brake-press head, used in forming metal shapes, was broken, as shown in Fig. 4, as the result of overload and extremely low shop temperature. A close-up view of the completed weld and reinforcement is shown in Fig. 5. The break was 30x4½ in. in size, and alignment was very important. The following materials and time were used for welding, not including reinforcing: Line up and prepare, 4 hours, 2 men; welding time, 11 hours, 2 men, 1 torch; oxygen and acetylene, 900 cu. ft.; rods, 175 lb.; charcoal, 20 bushels; weight of casting, 8000 lb.

The cast-steel bulldozer gear shown in Fig. 6 had two broken spokes. The only reason that could be attributed for these breaks was that the spokes were too light to carry the heavy load. There are many who do not realize that in a gear of this type the load must be transmitted through the spokes from rim to hub or vice versa. The illustration shows the completed job after it was arc welded.

We could easily have welded the two breaks with ample reinforcement and called it a job. But we could not conscientiously do that kind of job without explaining that further trouble would appear. So we received instructions to do a first-class job of rebuilding the gear to carry the load. The reinforcing strips and method of welding them are very plain. The two broken spokes carry much more welding than the other four.

The time and materials on this job were as follows: Welding time, 86 arc hours; 24 steel bars, 1x3 in., used for reinforcing; weight, 6000 lb.

A job involving a cast-iron metal brake-press side frame with two breaks required extreme care in alignment. A close-up view of one of the breaks is shown in Fig. 7, which clearly illustrates our method of tacking broken parts and shows how the tack materially assists alignment. We align a job by mechanical means first, then tack the parts together with the electric arc. We find frequently that by mechanical methods we are unable to bring the parts as close together as desirable; but that after tack welding with the arc, the contraction of the arc weld will draw the pieces together so that, as is shown here, only a hair-line crack is visible and frequently even that is not apparent.

The completed job, including the reinforcing lugs, is shown in Fig. 8. After the welds were completed to casting level, we made a mold of four fire bricks and built up the space inside with weld metal, thus forming the lugs, after which we washed and shaped the lugs with the torch.

Rod Scraps Added to Mold to Make Reinforcement

We have found that it does not pay to weld cast iron welding rods together that are under 6 in. in length. These we break up into slugs not over ½ in. long, and use them to reinforce the casting after the firebrick mold is set up and a bottom is secured by the welders. The helper then will put in one handful of these slugs

Fig. 9. Lathe Bed With Breaks Shown in Chalk.

Fig. 10. Repair Completed by Bronze Welding.

and one handful of flux. The welders follow this charge with their welding flames and welding rod to secure a solid weld. This is repeated until the proper height is obtained, usually 1½ to 2 in. Two No. 15 welding heads are used for this operation. A lug 4x8x2 in. high can be built up in about 10 minutes.

The time and material figures on this job are: Line up and prepare, 3½ hours, 2 men; 65 lineal inches of average 2½-in. welds; welding time, 10½ hours; oxygen and acetylene, 850 cu. ft.; cast-iron rod, 165 lb.; charcoal, 24 bushels; size of casting, 10 ft. high by 20 in. wide at the top and 40 in. wide at the base; weight, 5000 lb.

A 390-ton-capacity metal brake-press frame of steel-plate construction was broken and welded with reinforcing plates also welded on. The total time consumed in arc welding this job was

Fig. 11. This Repair Required a "Surgical" Operation With the Cutting Torch.

45½ hours for two welders, and 55 lb. of welding wire was used. Our problem here was to eliminate any strains that might be left in the frame due to contraction. This was taken care of by setting a screw jack in the front part of the frame or point of finish of the weld. The jack was screwed up to open the crack approximately ¼ in. As the weld progressed, the jack was gradually released until the weld was within a few inches of the end, at which time the jack was removed. At no time did the point of weld cover more than 2 in. in length, and this space was completely filled in before going any further.

The cast-iron bed of a single-purpose production lathe became broken in transit. The part broken out was in approximately ten pieces. Fig. 9 shows the bed with the underside up and with the broken part set in place after the many pieces had been bench welded, using cast iron. The original breaks are outlined. The breaks that remain are thoroughly grooved out to the full thickness of the base metal, as shown. We did not care to give this a severe preheat as we might injure the slides and runners which are a part of the base, so we placed an illuminating-gas flame on the under side and bronze welded completely around the broken section. The broken part was held in place by tacking with the arc. The completed job is shown in Fig. 10.

A material-crane axle, 4⅞x14 in. in dimensions when finished, was worn badly at the bearings and built up by arc welding in 15 hours.

Resorts to "Surgery" to Make Repair

Fig. 11 shows a steam-hammer cylinder of cast iron, weighing 3000 lb. This is what is sometimes referred to as a surgical operation, because we were forced to cut away the outside wall in order to reach the inner wall; and after welding the inner crack, we inserted the piece cut out and welded it back in place. In this job we preheated the whole base and about half way up the cylinder. The actual welding time was 6½ hours.

All the jobs mentioned have been selected as typical plant repairs, and every one of them has been successful and is still in operation.

Program Announced for Ohio Welding Conference

The program of the Third Annual Welding Conference to be held at The Ohio State University, Columbus, Ohio, Feb. 28th and March 1st, has been announced by Prof. O. D. Rickly as follows:

Wednesday, Feb. 28th

10:00 a. m. Address of Welcome, by George W. Rightmire, president, The Ohio State University.

Brief talks by W. D. Turnbull, junior dean, College of Engineering, and John Younger, chairman, The Department of Industrial Engineering.

"Welding of Clad Steels," by W. B. Keelor, Ingersoll Steel & Disc Co.

1:30 p. m. "Fabrication of the Boulder-Dam Gate Valves by Welding," by C. M. Candy, Westinghouse Electric & Manufacturing Co.

"Recent Developments in Oxyacetylene Machine Cutting," by R. F. Helmkamp, The Air Reduction Sales Co.

"Physical Properties of Metals," by P. W. Ott, professor of mechanics, The Ohio State University.

8:00 p. m. "Applications of X-Rays in Welding," by E. W. Page, General Electric X-Ray Corp.

Thursday, March 1st

9:30 a. m. "Modern Arc Welding and Its Applications," by K. L. Hansen, Harnischfeger Sales Corp.

"Brazing With Silver-Copper Alloys," by A. W. Swift, Handy & Harman.

1:00 p. m. "The Oxyacetylene Process in Metal Working," by W. S. Walker, The Linde Air Products Co.

"Copper Welding," by O. H. Menke, Hobart Bros. Co.

St. Louis Groups Hear Talks on Welded Tubing

The manufacture of electric welded tubing and pipe and the installation of these products in the field, was the subject of two illustrated addresses given by J. S. Adelson, chief metallurgist, Steel & Tubes, Inc., Cleveland, Ohio, before engineering groups in St. Louis on Feb. 6th. One meeting at noon was composed of the St. Louis Electrical Board of Trade, and the evening group was made up of the Industrial Engineers Section. Both meetings were held in the Hotel Statler.

Coco Cola Co. Orders Stainless-Steel Drums

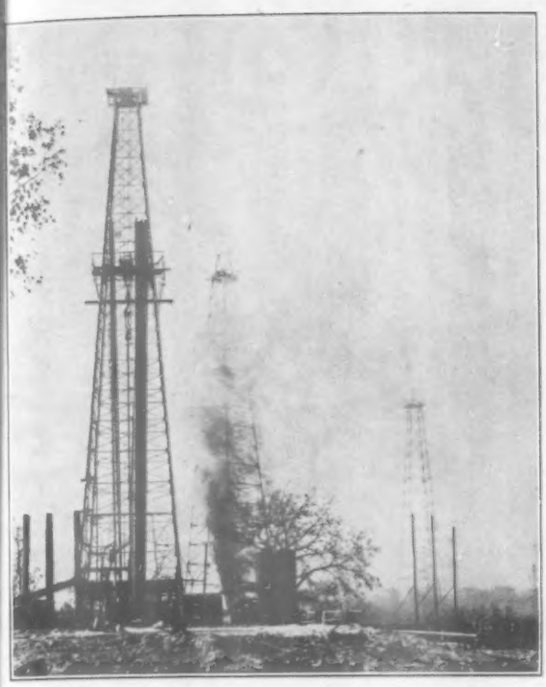
Following a period of extensive research, the Coca-Cola Co., Atlanta, Ga., has placed an order for 1000 stainless-steel drums for use in shipping their syrup to bottling plants throughout the country.

A portion of the new containers, which will replace wooden packages, are now

Welded Drum for Coca-Cola Syrup.

being fabricated by the Stevens Metal Products Co., Niles, Ohio, from low-carbon stainless-steel of 18-8 chrome-nickel analysis. A large share of the steel is Enduro, a product of the Republic Steel Corp., Youngstown, Ohio.

Each of the new drums will be of 55-gallon capacity and resistance welded. One of them is shown in the illustration. Low-carbon stainless was specified in order to avoid any possibility of corrosive action at or adjacent to the welds. All flanges and fittings will be of stainless steel, are welded.



Welding Applied to Oil-Well Drilling

By M. L. ROGERS

NOT until a welder has spent some time in a new oil field does he realize how closely related welding is to drilling. To show how dependent drilling is on the welding processes, I shall outline the details of drilling an oil well, or completing it for operation.

For convenience, I shall be the driller. We are going to start this well with a new $75,000 rig and string of tools, then we will not be constantly sending for a welder to make repairs.

The derrick is up and the rig is on the ground. There are three boilers, two boiler-feed pumps, two mud-hog pumps, the rig, and a string of 6-in. drill pipe; so we are ready to set up. First, we must call a welder for we have already found we need some holes cut in the derrick to accommodate this rig. Also, a split pipe must be welded on the head beam for the winch line to rub against to prevent cutting the beam. Two suction lines must be made up for the mud-hog pumps; these are made of 8-in. pipe of the desired length by welding a 3-ft. length at a 60° angle to lower into the mixing pit. Also, we must have a couple of 6-in. syphon jets made up to transfer the mud from one pit to another.

Welding and Cutting Speeds Up Pipe Work

This done, the welder is informed that the men hooking up the boilers want a lot of pipe cut and welded, for this is much quicker than cutting, threading and putting in unions. When the welder has completed this job, I am waiting for him to make up a 4-in. syphon to jet the water out of the cellar, which is under the derrick floor, and for him to make a pipe for the rat role to set the "kelly" in. By the time the welder has finished the jet and rat-hole pipe, I am back to tell him that a few changes have to be made on the chain guards. They do not fit up right, and one of my roughnecks (driller's helper) wants a couple of long bolts welded to the derrick to hang his cat lines on. In addition, there are many odds and ends of jobs for the welder to do, such as welding the ends of cables so they won't unravel.

Some drillers have a handle brazed onto the throttle valve, so they can spin it, also handles brazed on all the large valves around the mud-hogs, as they have to be opened and closed quite often and in rather a hurry. So one can easily see there is no limit of welding jobs.

Setting Up for Drilling

In about four days we are ready to drill and the welder gets three days' work out of the setting up, after which we are ready to drill for our surface pipe, which is the first string of casing. So an 18-in. fish-tail bit is screwed on, and down we start. We have to drill about 300 ft. to get through the quicksand and hit solid formation, but this is soon accomplished, and then we are ready to set the 14-in. casing.

We must have a welder to spot the collars of the surface pipe, for one cannot be too careful when drilling an oil well, since a slip might mean months of fishing and may even compel us to skid the rig and abandon the hole.

First, one end of the collars is spot welded in four places, 3 in. long. This is done while the 14-in. pipe is lying on the rack. The other end is tacked as the pipe is being put into the hole. Sometimes we get hung up going into the hole, but the welder is kept on the job sometimes as long as 36 hours, though there may really be only a few hours' welding to be done. Finally we get to the bottom of the hole and get the casing cemented in.

When the cement has set 60 hours, I call the welder back to cut the surface pipe off below the rotary table and bell out the end so the drill collars won't catch when going into the hole. Then an 8-in. flow line has to be saddled into the surface pipe and run to the slush pit; also a sample catcher has to be welded into the flow line. So on this trip the welder gets about 5 hours of work, and we are now ready to start on that long, hard grind of drilling to a depth of about 4300 ft., which is a shallow well for these days. The Oklahoma City field averages a depth of over 6200 ft. A well in California was drilled to a depth of 10,946 ft. What a lot of welding there must have been on that well!

Reclaiming Drilling Bits by Hard-Facing

We have contracted with a company which, for an agreed sum, would furnish the bits necessary to drill so many thousand feet. These bits are delivered to us and the used or dull bits taken back to the shop to be reclaimed. We are using fish-tail bits, which are easily reclaimed and very effective in ordinary drilling. These bits are reclaimed by a welder, by the following method:

A copper templet is clamped into place to form one wing of the fish-tail. Then it is built up to the original size and shape with electric-arc welding, usually using Stoody Self Hardening electrodes, after which the other wing is built up in like manner. It is then ground down to a perfect shape and through to clean metal. Then ¼x½-in. borium inserts are embedded about every inch along the cutting edge, followed by a coat of ground borium applied over the surface which would receive the most wear. This is then covered with a coat of Blackor or like material to prevent the borium from chipping off. The hard-surfacing material is applied entirely by the oxyacetylene torch. These

bits, when properly reclaimed, will last many times longer than a new forged bit. In the old days, when a bit was forged out to sharpen it a few times in the shop, it was all gone. Through the welding process of reclaiming, we put back what is worn off, so our bits will last almost indefinitely.

We Lose the Drill Pipe Down in the Hole!

While all this bit-reclaiming is going on, we are drilling at a steady rate. The rotary is revolving so fast it is fairly humming. The indicator shows the beacon end of the cable to be almost slack, which means we have the weight of the whole string of tools on the bit! All of a sudden a cave-in occurs down in the hole and before I can shut off the throttle, off goes the drill pipe! What a mess!

So we come out of the hole with what drill pipe we have left. I soon find out we have about 1800 ft. left in the hole—and there is nothing certain about a fishing job. It might mean three days and it might mean three months or more. We might even have to abandon the hole and skid the rig.

After the bad news has been broken to the tool pusher, he starts to make preparations for the fishing job. First, he sends for a string of old drill pipe, in order not to ruin any more of the new string. Next, a welder is notified to be on the job when the pipe arrives; also a variety of fishing tools are sent for from a supply house. At last we have all of our tools together, as well as the welder. We first screw a fishing tool onto a joint of our borrowed pipe; then we start in the hole, welding every joint with about three good tacks. If we were lucky enough to grab the lost string of drill pipe, we would try to back out the broken joint so we could stab another joint of drill pipe, then hook it all up as before, start our pumps and circulate it loose.

Finally we are down to the lost string. After many discouraging attempts, we finally hook it and secure a good hold; then our rotary is set to back up—we back up until the engine fairly groans. At last the pipe gives way with a bang! So we start out of the hole and anxiously wait to see whether we have broken off the old drill pipe or uncoupled a joint in the lost string. When going out of the hole we have to cut the tacks loose on every fourth joint so the pipe can be stacked in the derrick. At last we are out and we find we have three joints of the lost string, leaving us a clear collar to couple on, so we go after the rest of it. This time the welder doesn't have to tack it, for we will be turning the string to the right, so he is sent home. But later, when we have completed the fishing job, the welder is called back to cut the rest of the tacks loose so the string can be uncoupled to single joints and be taken out of the derrick. At last this job is completed, and again the rotary is spinning around, drilling the hole deeper.

After a Fire, the Cutting Torch Is Used to Dismantle the Twisted Wreckage of the Derrick.

As this is proved territory, we must make preparations to take care of the oil when the well comes in, so a battery of small bolt-up tanks are set up, and a welder is called to hook them up, which is about a two-day job.

Preparing to Set the Casing

By the time all this is done, the drill has reached 3900 ft. and we are ready to set the 9-in. casing. So the welder is called to cut the flow line and surface pipe off just above the first collar, then cut out the "dutchman" so a braden head can be screwed in to hang the 9-in. casing in the hole. If the casing were to be set on the bottom, it would result in a crooked string.

The welder also has to weld the shoe all the way around and spot weld the two floats and first three collars. This is done by first spotting one end on the rack, then the other as the casing is going into the hole. All this will take about a day, for the welder usually is detained a great deal.

After the casing has been run and the cement pumped in and set for 72 hours, the welder again is summoned to weld in a 6-in. flow line and cut off and bell out as he had the surface pipe. On this trip a few jobs are found for him: the flanges are leaking on the mud-hog pump suctions so they have to be brazed, and four collars are found to be cracked on the 4-in. string of drill pipe which will now replace the 6-in. drill pipe. The collars are always set on too tight to be backed off with a pair of tongs, so the welder has to cut them off, and if in doing it he nicks the threads on the drill pipe it will cost his company a lot of money and probably him his job. So an oil-field welder must be very skilled in his profession.

This string of pipe has made a number of holes, so after making further inspection I find that a number of collars are worn around the shoulder and would wedge in the elevators. So it is necessary to have the worst of the collars built up with Stoody Self Hardening electrodes. Quite often a whole string of 6-in. drill collars have to be built up so they may be used over again.

While we are drilling on our last stretch, an all-welded separator is being set up, requiring a great deal of cutting and welding.

Soon our samples show that we have drilled through the cap rock and are now topping the oil sand. Therefore, we are ready to set the 6-in. casing, so the welder is called, and he goes through the same operations as when the 9-in. casing was set, except that this time there is no flow line to weld in, but the "Christmas tree" has to be hooked up, and the separator tied in. The "Christmas tree" consists of from one to three master valves, a flow line running to the separator, and a blow-off line running to the slush pit for cleaning the well. After all of this is completed, including the cementing and drying of the cement, we are ready to bail in and watch it flow.

Welding and Cutting Necessary in Boiler Reconditioning

Now we must get ready to move to another location, but our boilers are in bad shape. The flues are leaking in all three boilers. We have 98 3-in. tubes to the set. The water has been terrible—full of jip and jum. The flues are all scaled up and mud is baked on the flue sheet until we can no longer hold a role. A welder is called to cut the flues out so they can be cleaned and re-tipped. A tip is welded on by oxyacetylene; then a boiler maker puts the tubes back. These boilers are rated at 250-lb. working pressure, but quite often we carry 300 or 350 lb.

Now that I have outlined the operations of drilling a well and the welding necessary, one can imagine the great amount of welding created when derricks tower above the horizon like forests. Tank farms, pump stations and

refineries spring up over night like magic cities; but, please understand, this article does not begin to touch on all phases of oil-field welding. In fact, around a drilling rig alone, there are many things to be welded that have not been mentioned.

Sometimes a well comes in wild. If so, a welder makes up most of the equipment and apparatus for capping it.

When a well catches on fire, a welder is called to make up fire shields and other fire-fighting equipment. Also, when it has been extinguished, the derrick which has collapsed under the heat has to be cut away.

Thus, the welding and cutting processes are indispensable in the carrying out of oil-field operations, and the operation of drilling alone requires a vast amount of welding to effect speed and economy.

"Long Tom" Helps to Dismantle a Bridge

By GEO. CALMBACH

When a section of railroad in Missouri was recently abandoned, it was necessary to scrap a single-span bridge, 62 ft. long, weighing 50 tons. The bridge rested on two piers about 35 ft. above the creek bed. Each of the two side girders were 62 ft. long and 6 ft. wide and weighed about 15 tons. The cross girders were 32 in. wide and 15 ft. long, while the center running girders were 24 in. wide and 12 ft. long.

I was sent to remove this bridge with one cutting operator and an Airco-D-B Style 8000 cutting torch. The bridge had to be cut into charging-box sections, 18 in. by 5 ft. Lacking any facilities, other than the cutting torch, I first planned to cut the bridge from the top down, feeling that the structure would sustain itself while being reduced in top weight. However, after a strip 18 in. wide was cut across the top of one of the large side girders for a distance of 25 ft., the bridge began to buckle.

Therefore, there was only one course left. That was to cut out the center sections, leaving the two side girders standing. This we proceeded to do. After cutting one of the cross sections and dropping it into the creek bed, I found that even with this weight gone the bridge continued to buckle.

This made the bridge unsafe for us to be on while cutting the other sections entirely off. Never at any time while I have been in charge of, or supervising, any work have I asked anyone to do something that I would not do myself. Naturally, on this bridge job I could not send

A 25-Ft. Cutting Torch.

my workmen onto an unsafe structure unless I was right with them. My presence gave them the confidence necessary to work the cutting of the cross sections successfully.

I found that we could safely cut the cross sections loose, except across the top. While doing this, I kept an accurate check of the action of the bridge. The buckle increased, especially after we cut the second section at both ends, leaving the top intact.

Then we were at a loss for a way to cut the two ends loose without being caught in the drop of the sections. So I thought of "Long Tom." I took a sapling, about 25 ft. long, to the small end of which I attached the torch. The other end was held by the cutting operator and helper. "Long Tom" was then balanced in the center by a wire suspended from a plank placed across the top of the side girders, as shown in one of the illustrations. I regulated the torch with sufficient oxygen to cut through the top of these sections, which were 12 in. wide and from ¾ to 2½ in. thick.

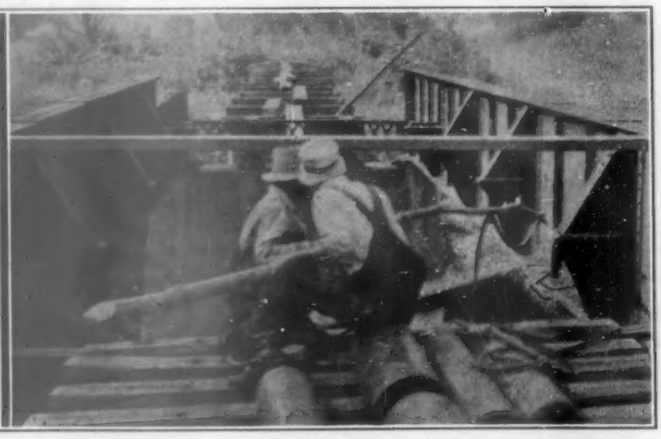
The only difference from regular torch adjustment was that I used an excess acetylene flame and had to open the high-pressure cutting valve before we extended the torch over the part to be cut. It was a simple matter then to cut the tops of the cross sections, dropping them into the creek bed. We then cut them into sizes 18 in. by 5 ft., ready for shipment to the mills.

As nearly as I could estimate, there was about 1200 ft. of cutting, and about 250 ft. of that was cutting of two to five thicknesses of metal from 1½ to 3½ in. in thickness. The actual cutting time was 74 hours; oxygen consumed, 5830 cu. ft.; and acetylene consumed, 800 cu. ft. It required just 10 hours to drop the entire bridge into the creek bed. On this piece of work I used only No. 2 and No. 3 Style 25 cutting tips.

Reduces Price of Pipe Welding Manual

The "Standard Manual on Pipe Welding," published by the Heating, Piping and Air Conditioning Contractors National Association, 1250 Sixth Ave., New York, N. Y., has been reduced in price to $2.50 per copy. The "Specifications and Standards for Welding" contained in this Manual have been incorporated in the "Code for Fair Competition" of the heating, piping and air-conditioning contractors' division of the construction industry, in which Article III, Section 1(m) reads: "When the welding process is used the work shall be done in accordance with the Welding Standards and Specifications of the Association."

Cutting the Side Girders Made the Bridge Unsafe.



"Long Tom" Severs and Drops One of the Cross Members.

Applications of Welding to the Boilers, Piping and Equipment of a Mercury-Steam Power Plant

Paper read at a joint meeting of the New York Sections of the American Welding Society and American Society of Mechanical Engineers, January 16, 1934.

By R. H. ROGERS
General Electric Co.

THE new power station at the Schenectady Works of the General Electric Co. is unique in several ways. First: it is owned by an industry and operated by a utility, the installed capacity being 26,000 kw. for the use of the New York Power & Light Co. and 650,000 lb. of steam per hour for the use of the General Electric Co. Second: it is a mercury-vapor-steam plant, with a product of the mercury-vapor cycle of 325,000 lb. of steam per hour and 20,000 kw. Third: it is an outdoor station in that the main bulk of the steam and mercury boilers, the mercury and steam turbines and principal appurtenances are entirely exposed to the weather. Fourth: it is an arc-welded station throughout — structure, boilers, piping and equipment. Rivets and bolts are almost entirely absent except in some purchased equipment which is of standard manufacture.

Two boilers are installed side-by-side, each with its own complement of coal handling, storing, pulverizing and feeding equipment and other auxiliaries. One is a more or less conventional steam boiler for producing 325,000 lb. of steam per hour at 400 lb. pressure and 750°F. temperature. The other is a mercury-vapor boiler with capacity for operating a 20,000-kw. turbine; the upper portion of its furnace has mercury walls and the lower portion has water walls which produce 85,000 lb. of steam per hour.

The mercury vapor has a pressure of 140 lb. at the boiler and 125 lb. at the turbine; the temperature is 958°F. The condenser-boilers (these are the condensers for the mercury turbine) and furnace walls deliver 325,000 lb. of steam per hour. Steam transport lines involve 1¾ miles of high-pressure lines and water-return lines carried in tunnels and on bridges to the older power stations, from where it is distributed for testing, manufacturing and heating.

Operators Qualified for Class I Code Welding

The structural work was fabricated and erected by the American Bridge Co. The piping was fabricated and erected by the Pittsburgh Piping & Equipment Co. The mercury-turbine equipment and accessories were fabricated in the General Electric plant. From the regular welding forces of the General Electric Co. some thirty men were qualified through the Hartford Steam Boiler Inspection & Insurance Co. for Class I code welding. Of these, six were employed by the Pittsburgh Piping & Equipment Co. for four months in erection work.

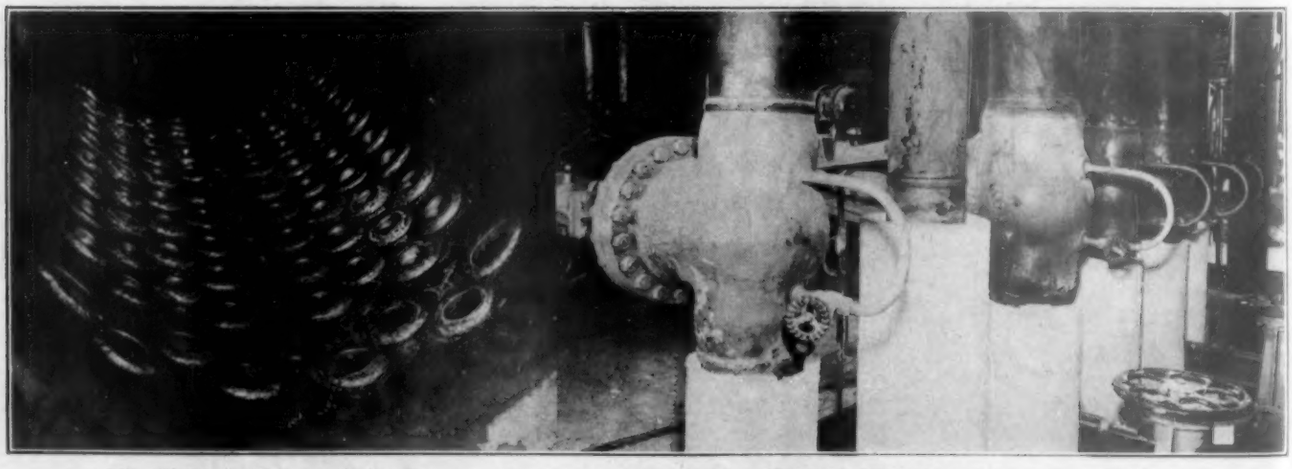
Detail specifications were prepared covering the procedure for qualifying welders and for the shop and field welding as well.

The mercury boiler consists of seven horizontal, parallel drums of 30-in. welded pipe, 4 in. thick, suspended from trusses. Hanging down from each drum are 440 porcupine tubes welded inside the drum. In spite of the fact that the welders had to work in this 30-in. diameter space under forced ventilation, only two leaks developed in the 3080 tube joints during the hydrostatic test. The mercury liquid heaters and mercury furnace walls are examples of intricate shop fabrication. Among the other heavy units code-welded in the shop were the govenor and safety-valve body for the mercury turbine and the mercury-turbine condensers.

Employs Flangeless Fittings and Large-Radius Bends

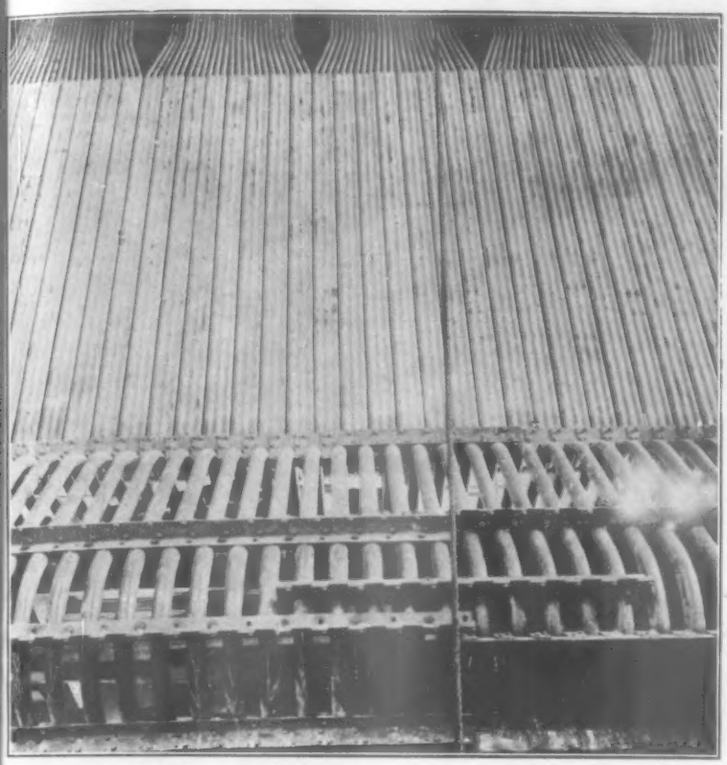
The piping involved carries liquid mercury, mercury vapor, steam at 400 lb. pressure and 750°F., and water at 600 lb. pressure, as well as pipes for oil, gas, pulverized fuel and air. The pipe in general is extra-heavy, ranging from 1 to 18 in. in diameter. Flanges were avoided wherever possible, flangeless valves were used, and long-radius bends prevail at the turns.

Among the many features of interest,



Tube Welds in Mercury-Boiler Drum.

Position Welds in High-Temperature-Steam Lines.



The Side Walls of the Mercury Boiler Is Composed of Mercury-Filled Tubes Enclosed Between Welded Corrugated Plates.

■

WATER or steam lost through leaking gaskets and caulked seams in a steam power plant is readily and cheaply replaced by adding make-up water to the boiler. Not so, where the boiler contains mercury instead of water. Absolute assurance against leaks is even more desirable in the mercury-vapor power plant than in the steam plant, and the solution to the problem lies in welded joints.—Editor.

■

one of the most important was the design of the steam lines between the power station and the General Electric works. These lines convey steam for heating and turbine testing, and for manufacturing purposes, from the new power plant to distributing points in two old power stations. The total distance involved is 3735 ft., requiring the installation of 4865 ft. of 14-in. high-pressure lines and 4433 ft. of condensate return lines, mostly 8 and 10 in.

Steam is delivered at 400 lb. pressure and 750°F. at a maximum rate of 500,000 lb. per hour. The transmission of so much energy through this distance, together with the high temperatures, high pressures, and the accompanying expansion problems, made this a major piece of work, adjunct as it is to one of the most interesting power stations in the world.

The steam and return lines are carried in a reinforced-concrete tunnel. Short sections, where entry is made to the old power stations, are carried on skeleton bridges, because they cross various obstructions that precluded the use of tunnels.

In service, the 14-in. high-pressure lines contain 2½ tons of steam, traveling at a speed of 4000 ft. per minute. The temperature rise to 750°F. involves, in the 4865 ft. of 14-in. pipe, a total linear expansion in the neighborhood of 30 ft. with a potential pipe thrust of 400,000 lb. Without insulation, the radiation at 750°F. would be the equivalent of more than 20,000 kw., or equal to the total output of the mercury turbine! These figures make evident the responsibility of the anchorages, the expansion joints, the welded joints and the insulation.

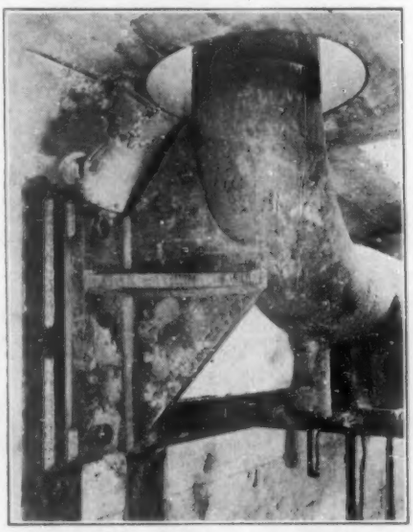
Welding of High-Pressure Steam Piping

The high-pressure piping is seamless and has a ½-in. wall. The 35-ft. lengths weigh about 2300 lb. each, and were tack welded to form 200-ft. lengths, the welding of the joints being completed as the sections were rotated. Position welds joined these sections to flangeless slip expansion joints, which in turn were welded to H-sections embedded in the tunnel side wall, thus providing a rigid anchorage. Self-sealing packing is used under light mechanical pressure, as the steam pressure tends to press the truncated-cone rings against the pipe. The joint provides for 18 in. of expansion, of which from 14 to 18 in. is actually used.

Weld-fabricated compound roller supports are located under the pipe through the length, at 25-ft. intervals. Approximately twenty-two 90° bends were used; those leading to the bridges being of 12-ft. radius. In general, anchor brackets were welded to the short-radius bends and in turn to H-frames embedded in the concrete walls or roof.

Two kinds of construction were used in building the bridges. The parts nearest the tunnel are built to carry the pipe by suspension, to allow for the expansion of the vertical runs. The pipe next to the buildings is mounted on top of the bridges. A continuous H-section is laid between the bridge and the pipe in order to relieve the structure of possible expansion strains. Should an expansion joint in the pipe fail to slip, the strain will be placed on the practically independent H-section rather than on the bridge structure proper.

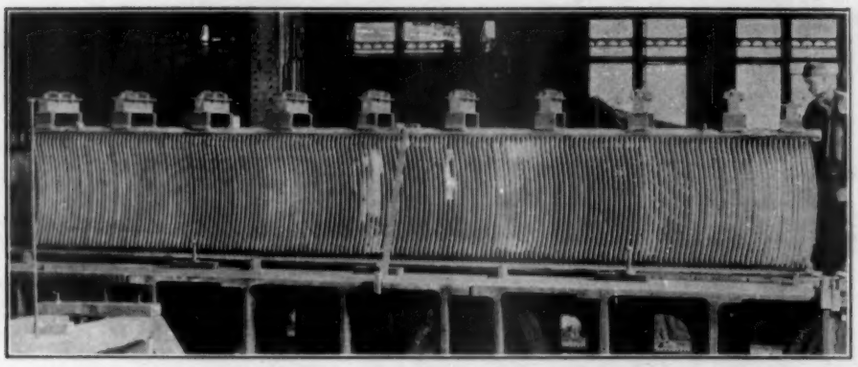
During the transition period it was necessary to deliver steam for heating factory buildings as the boilers were being removed from one old station. This necessitated immediate insulation of the pipes, as the bare-pipe radiation would



Welded Pipe Bend and Anchor in Tunnel.

have dissipated most of the heat. The insulation was completed before the joints were tested, and upon applying the 225-lb. pressure then available, no leaks developed.

Stands for the expansion-roller supports were fabricated and welded in



One of the 24 Mercury Liquid Heaters Requiring Over 8,000 Welds.

place. The pipe was brought in through the hatchways and hauled to location on trucks. Fusion rings, 1 in. wide by ⅛ in. thick, rolled from strip, were tack welded in the delivery end of each pipe, the welds being made at the inside edge of the ring within the pipe. The lengths were then lifted onto the stands and placed on temporary roller dollies. Six lengths, with the last one cut to make approximately 200 ft., including the chromium-plated sliding section in the expansion joint, were strongly tack welded together at six points at each joint. A split gear was clamped on and the 200-ft. length was rotated at about one revolution in six minutes, or at a peripheral speed of a little over 7 in. per minute, by a small adjustable-speed motor operating through a gear reducer and chain.

Roll Joints Welded With Five Passes

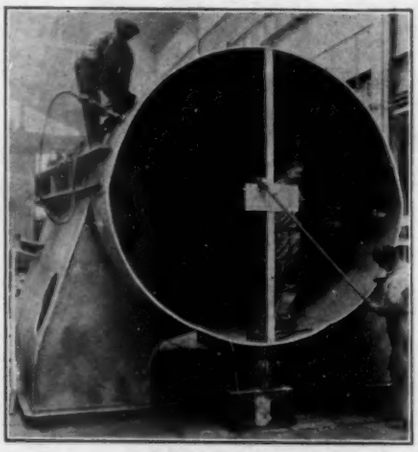
The welding of roll joints involved five passes, using heavily coated G-E W-21 electrodes, starting with 3/16-in. at 200 amperes and finishing with ¼-in. at 275 amperes. After each pass the slag was chipped off with an air tool, which also provided some peening effect. The first pass was laid straight, and succeeding passes were oscillated increasingly as required to fill the 60° beveled groove. The last pass was slightly crowned and was about ¾ in. wide. The welding was all done by hand, using the single-operator type of motor-generator welding set.

Only one position weld was required at each expansion joint, that being where the 200-ft. line was welded to the stationary member of the expansion joint. These position welds were made with G-E W-20 electrodes in four passes. The weld passes were started at the bottom of the joint and finished at the top, alternating the halves. The succeeding passes were started and finished at staggered points to prevent concentration of starting and finishing joints.

After the position welds, the roller dollies were removed and the roller support members were welded to the underside of the pipe and to the stands. The expansion joints were then anchored by welding. Fitted blocks were welded between the embedded H-section and the joint anchorage bases.

The 8-in. and 10-in. water pipe was handled in the same manner as outlined above, except that the expansion joints were spaced 400 ft. apart. The expansion joints were fitted with anchorage members by the manufacturer, but the anchorages on the bends were fabricated at the Schenectady works. The vertical risers, two of 28 ft. and one of 34 ft., were position welded with G-E W-20 heavily coated electrodes.

Nine test specimens from tested welds were subjected to reduced-section tension tests, nick-break tests and bend tests. Specifications covering in detail the entire welding procedure were rigidly adhered to throughout the fabrication of these pipelines. It is significant that not a single leak developed under steam test among the great number of roll welds and horizontal and vertical position welds.



Checking the Welded Shell of One of the Two Mercury-Condensing Boilers.

More Than a Ton of Electrodes Used

The electrodes used on the pipe and accessories amounted to 2155 lb. The welding cost was 3% of the cost of the line exclusive of tunnel and bridge construction.

Gas Manufacturers Elect Officers

Officers elected at the 21st annual meeting of the Compressed Gas Manufacturers Association, held in New York City on Jan. 25th and 26th, were as follows: President, F. A. Eustis, Virginia Smelting Co.; first vice-president, Eugen Becher, Metal & Thermit Corp.; second vice-president, W. F. Heath, Crystal Carbonic Laboratory; and secretary-treasurer, Franklin R. Fetherston (re-elected).

Elicits Manuscripts for International Congress

The Fourth International Congress for Applied Mechanics will be held in Cambridge, England, July 3 to 9, 1934. Among the subjects to be discussed are materials, including elasticity, plasticity, fatigue, and crystal structure, and rational mechanics, which includes vibrations of structures and machines. Those intending to participate by the reading of papers are invited to intimate as soon as possible the general nature of their manuscripts. Summaries about 300 words in length will be required about April 1st. Inquiries should be addressed to the Applied Mechanics Division of the A. S. M. E., 29 West 39th St., New York, N. Y.

Carbide Manufacturers to Offer Prizes

An international competition relating to uses of calcium carbide or acteylene has been organized by French manufacturers of calcium carbide in conjunction with the International Syndicate for Calcium Carbide at Geneva. The competition, which will open April 1, 1934, and close on Sept. 30th following, is for the purpose of stimulating and recompensing inventors, technicians, and laymen of all countries for studies, publications and research work that might result in increased use of calcium carbide, acetylene or oxyacetylene welding, with the exception that the production of synthetic chemicals from an acetylene base is not included.

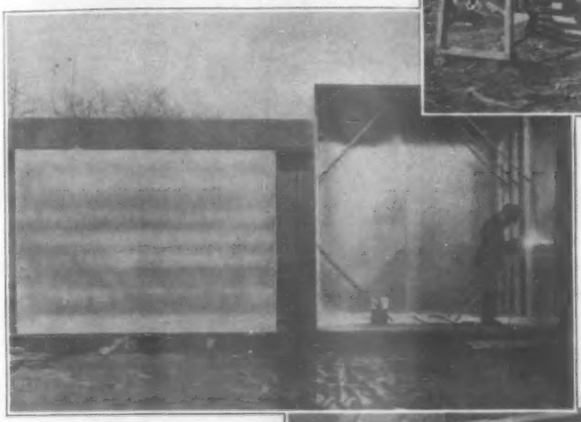
Fifty thousand French francs are available for distribution as prizes by the Competition jury. It is planned to divide this sum into four prizes: one of 25,000 francs, one of 15,000 francs, and two of 5000 francs each.

Further information regarding the competition may be obtained from the General Secretary at the Central Office for Acetylene and Autogenous Welding, 32 Boulevard de la Chapelle, Paris, France, or Miss M. M. Kelly, American Welding Society, 29 West 39th St., New York, N. Y.

WELDING NEWS
• IN PICTURES •

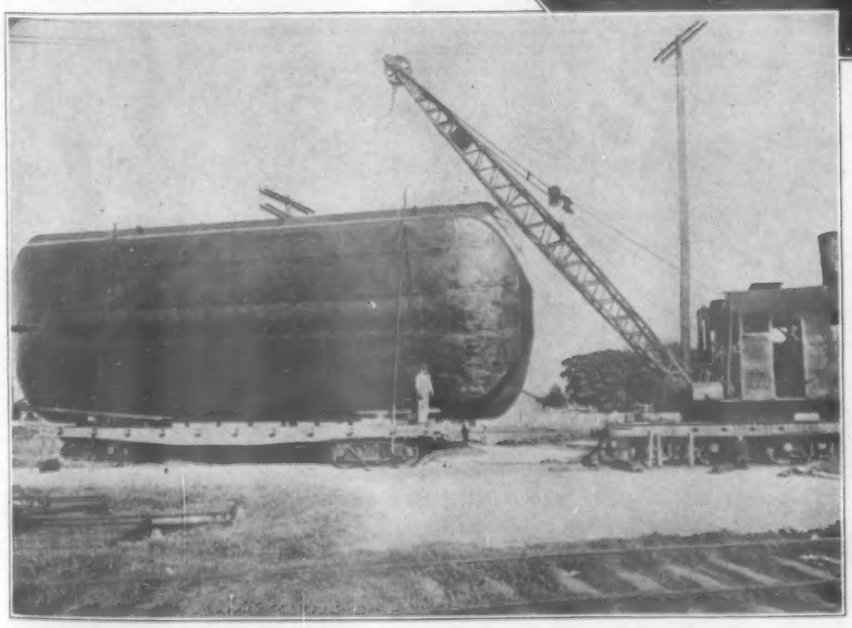
• A welder's bedroom! A roar of rushing water wakened H. H. Cockrum, welding-shop owner of Los Angeles, from his slumbers and he barely escaped with his life. This small bedroom, all that is left of his home, was carried off by the flood.

• A cut-off saw of the swinging type, all A. C. arc welded, built of car frames, by Chas. A. Barrett, blacksmith and welder, of York, Nebr. Total weight, 2250 lb. Mandrel will take up to a 40-in. blade.



• For transporting the huge welded Boulder Dam penstock sections from the fabricating plant to the dam site, the world's largest trailer will be called into use. Of welded and riveted construction, it will support 185 tons. Furnished by the C. R. Jahn Co., and built in the shops of the LaCrosse Boiler Co., LaCrosse, Wis.

• Tanks of 3/16-in. 3S aluminum, 10 ft. square and 7 ft. high, with 3-in. angle stiffeners welded to the sides, with corners braced on the inside, using the shielded-arc process with Lincoln "Aluminweld" electrodes.



• One of six all-welded steel barges turned up on side, showing welded details of bottom. Each barge is 60 ft. long and 20 ft. wide, with hulls and decks fabricated of ⅛-in. plate. Depth is 3 ft. and draft 6 in. Made by Equitable Equipment Co., Inc., New Orleans, using General Electric welding machines and electrodes. All six barges will be shipped to Central America.

Book Reviews

INDUSTRIAL RADIOGRAPHY, by Ancel St. John and Herbert R. Isenburger. 6x9 in.; 232 pages; 76 illustrations and 10 tables. Cloth binding; price, $3.50 plus postage. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y.

Dispensing with technical verbiage as far as possible, the authors of this book set down in simple language the early history of radiography and its recent development and use in the industrial field. They give the reader an understanding of the nature of x-rays, their behavior, their effect on materials, how they are produced and controlled, their applications to industry, and interpretation of radiographs. The applications mentioned are entirely related to inspection, only a few paragraphs being devoted to x-ray diffraction analysis and atomic structure. One chapter is given over to gamma-rays and their use in making radiographs.

The proper set-up for industrial radiography is described at length, and detailed information is given on the procedure of operation. In a chapter on the interpretation of radiographs, exographs are reproduced and critically discussed both as regards the interpretation of the images and as regards the procedure of making the images and developing the negatives and prints. Consideration is also given fluorscopy, in which no negatives or prints are used, and especial caution is given regarding the protection of personnel in this case.

A very informative chapter is devoted to welded vessels and structures, and cases are cited of how the x-ray is used to develop correct procedures for welding various ferrous and non-ferrous metals and alloys.

Instruction is given for estimating operating and cost data, using tables and charts giving prices of equipment and operating costs.

The book includes an extensive bibliography and an index.

LESSONS IN ARC WELDING. 8½x 11 in.; 58 pages; with diagrams. Mimeographed; paper binding; price, 50c prepaid, foreign postage 25c extra. Published by The Lincoln Electric Co., Cleveland, Ohio.

These 28 lessons in the arc welding of carbon steel take the student through the elementary principles of arc-welder design, the use of protective devices, controlling the heat, striking the arc, and manipulation of the electrode. Flat, horizontal, vertical and overhead welding, and butt, lap and tee welds are taken up in individual lessons. Consideration is given to forces of expansion and contraction and to the use of the metallic arc in cutting. The new student of arc welding who is not in a position to receive personal instruction from a competent welder would derive a great deal of value from these lessons. Though elementary in character, they also contain some valuable pointers for the welding operator who has passed the "novice" stage. These lessons are based on the course in arc welding given by Arthur Madson in the plant of The Lincoln Electric Co. at Cleveland. Many hundreds of successful welding operators have been under Mr. Madson's tutelage.

STEEL FRAMING FOR SMALL RESIDENCES. 8½x11 in.; 54 pages; with illustrations and tables. Paper binding; price, 50c. Published by United States Steel Corp. and subsidiaries.

In view of the high interest being shown in steel-framed residences, this book is a timely and valuable aid to architects, builders and fabricators in the residence field. It contains reliable information on the safe, practical and economic use of steel for residence framing. An example is given, with detailed steps, drawings and photographs, showing how the arrangement and sizes of all the steel members needed in framing a typical house may be easily determined. Five different steel framing systems are illustrated, together with residences employing each system. Rules for proportioning individual members are given and their selection is made easy by reference to specially arranged tables of safe loads. A selected group of steel products suitable for residence framing is listed for ready reference.

ARC WELDING HANDBOOK, by C. J. Holslag. Seventh edition; 5x7½ in.; 274 pages; 49 illustrations. Paper binding; price, $2.00. Published by the author.

For years this book has been a standard text among students and users of arc welding. The new material in this seventh edition comprises an appendix containing chapters on "Shielded Metallic Arc Process," "The Normalizing Electrode," "Hammer Annealing and Other Peening and Caulking Uses," "Why the Flux-Coated Electrode?" and "Some Speculations Into the Explanation of Fusion."

Job Shop Promotes Educational Meeting

At the meeting of the New Britain, Conn., Section of the American Society of Mechanical Engineers held on Feb. 7th in the State Trade School Auditorium, addresses were given by two well-known speakers in the welding field—W. R. Ost, of the Applied Engineering Department of the Air Reduction Sales Co., and J. F. Lincoln, of The Lincoln Electric Co. Mr. Ost's topic was "Improved Methods of Welding Medium-Pressure Piping," while Mr. Lincoln substituted for E. W. P. Smith in a paper on "Welding as Applied to the Design and Construction of Machines, Jigs and Fixtures."

The Storts Welding Co., of Meriden, Conn., arranged the educational part of the program, and some of their welders gave demonstrations of metallic-arc welding, including the making of recommended types of welded joints for standard structural shapes. The Aircoweld process as applied to pipe welding, a "Radiagraph," a pipe-beveling machine, and a tensile-testing machine were also demonstrated.

Chicago Meeting on X-Rays and Pipe Welding

The program of the Chicago Section of the American Welding Society, scheduled for February 16th at the Bismarck Hotel, included a paper on "Welded Piping in the New Marshall Field Building," by Mr. Hoyer, of Robert Gordon, Inc., and an address on "Industrial Uses of X-Rays," by E. W. Page, of the General Electric X-Ray Corp.

The Chicago Section are sponsors of a special meeting to be held on Feb. 20th in the Chicago Lighting Institute rooms on the 39th floor of the Civic Opera Building, 20 N. Wacker Drive, at which C. H. Jennings will speak on "Welding the Boulder Dam Intake Gates," and W. W. Reddie will discuss "New Developments of Welding Machines and Equipment." Both of these men are widely known in the welding field as members of the research and welding departments of the Westinghouse Electric & Manufacturing Co. at East Pittsburgh, Pa.

Speaks on Welding in the Oil Industry

"Welding for the Oil Industry" was the subject of an interesting talk which was the feature of the January 18th meeting of the Los Angeles section of the American Welding Society.

The talk, which was made by George Raymond, chief engineer of Black, Sivalls & Bryson, of Oklahoma City, Okla., was illustrated with picture slides and dealt principally with the welding of pressure vessels. The talk was followed by two interesting reels of motion pictures of the bringing-in and flowing of wild oil wells in the Oklahoma City oil field, which were interestingly described by Mr. Raymond as the pictures progressed.

A short business session followed, during which officers were elected for the

coming year as follows: Chairman, Frank A. Longo, of the Southern Pacific Railway; vice-chairman, Frank L. Howard, of The Smith Emery Co.; and secretary, Charles De Long, of the Air Reduction Sales Co. The following Executive Committee was appointed: "Pete" Sterkel, of The Western Pipe & Steel Co.; V. M. Goode, C.M.M., (U. S. Navy) stationed on the *U. S. S. Medusa;* C. E. McGinnis, Board of Mechanical Engineers, City of Los Angeles; J. C. Blake, of the Victor Welding Equipment Co.; and B. M. Laulhere, of the Southern California Gas Co., who is the outgoing chairman.

New York Will be Host to Next Metal Congress

The 16th annual Metal Congress and Exposition will be held for the first time in New York City, on Oct. 1 to 5, 1934. New York was unanimously selected by the Board of Trustees of the American Society of Metals (formerly American Society for Steel Treating) at a meeting held in Cleveland on Jan. 19th. The Exposition will be housed in the new Port of Authority Building, a 22-story structure at 14th St. and 8th Ave. The entire second floor, with 165,000 sq. ft. of floor space, has been reserved. As in former years, an attractive technical program will be given concurrently with the Exposition, in which several of the technical societies will participate. Floor plans for the Exposition will be ready about March 15th, according to W. H. Eisenman, director of the Congress and Exposition.

Discusses Welding of Power Plant Equipment

The part played by welding in the commercial development of the mercury-steam principle of electric-power generation, was the subject covered at the joint meeting of the New York section of the American Welding Society and the Iron and Steel and Power Divisions of the American Society of Mechanical Engineers, held on Jan. 16th, at the Engineering Societies Building, New York City.

"Applications of Fusion Welding in the Boilers, Piping and Equipment of the General Electric Company's Outdoor Mercury-Steam-Electric Power Plant," was the subject of the paper presented by R. H. Rogers, of the General Electric Co., in which was depicted in detail the use of welding in the building of the recently completed plant at Schenectady, N. Y., with particular reference to the welding in the mercury boiler.

The application of structural welding in the General Electric mercury-steam-electric plant was described by H. M. Priest, formerly of the American Bridge Co. and now associated with the Railroad Research Bureau of the U. S. Steel Corp. Both papers were illustrated with interesting slides. A discussion of the papers followed their presentation. F. T. Llewellyn, research engineer, U. S. Steel Corp., and past president of the American Welding Society, presided.

Get "*H. O. T.*" on Welding

■ Edited by
H. O. T. RIDLON
Welding Consultant, Joliet, Ill.

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

Step on the Gas and Sell

The thought for the month: "The man behind the windshield is just as important as the man behind the headshield." And, mister, thar's something to cajer upon! And I mean just what I say, and to put it another way is: Sell, brother, get out and sell, and you'll see the old "biz" taking on new life and the profits coming in steady and you'll throw that old red ink plumb out of sight. Yes, sir, welding can be sold!

Last month, you remember, I told you about those two brothers that were getting off on the right foot with the New Year. Gosh, are those kids going to town! They've forgotten that there ever was a time that "biz" was on the hummer. And it has been done by selling and by getting out behind the good old windshield and bringing in the business. Their shop looks like a place of business and things are humming eight hours every day. 'Tis hard to believe, I know, but it can be done if you put some real thought behind it; build a plan that will build a business and then work that plan for all there is in you. Expressing it another way: Build the foundation for your business structure for a hundred-story building. Try to make a ten-story building and if you have it in you to go higher, you can do it with safety. Make your foundation plenty good and strong. Honest, you can't miss.

Today, I was talking to the oldest of these brothers, and I feel that next month I can tell you their complete story. And I'll try very hard to get them to tell it to you in their own way. It should be interesting.

• • •

Get Out to the Welding Conferences

In the last issue our good editor ran a line about welding conferences to the right and to the left of us, coming in fast profusion. I had looked forward to going to the Iowa State College Conference at Ames, Iowa, which I am told was swell. But the press of business and my Boss prohibited my going. I sure hated to miss it, for there I expected to see many of my old friends from those parts and have the great privilege of making more. These welding conferences are great stuff and you should not miss one of them that is within range of your town (and by range, I mean a day's drive). There's a lot to see at them and much from which you can profit if you will take advantage of all they offer. And the interest YOU show in the conferences is that which keeps 'em alive.

• • •

Use Good Cable for Your Arc Welder

Nice eye, Mr. Chaffee. Your 12 rules for the birds that have "the build your own fever" are swell. But I hope the boys that read it will read it well, for there are some ifs, ands and buts in those rules that really should be brought out very strongly to the inexperienced who want to build their own machine that might be passed over lightly and should not be. I trust that some of our good friends don't misunderstand you as they did me, when I wrote on this very delicate subject. I would like to add two suggestions to yours for these build-your-own boys. Buy good cable that is suitable for arc-welding. And don't be "Scotch" when it comes to the electrode holder and head-shield; buy the best that the market has to offer and keep them in good condition.

• • •

Good Stuff for the Contest

Remember, the contest that I spoke about in the January issue closes Feb. 28th. Some darn smart suggestions have come in—but the winner hasn't been picked yet. I'm to be the only judge, and don't forget you all can't be winners. We'll try to publish as many of the best ideas as we can and give the devil his due.

It promises to be a very interesting collection of brain storms. So let's have yours, for I might just happen to believe you were a pretty smart boy.

• • •

Been working on two darn interesting "Out of the Scrap Pile" jobs which I had hoped to give you the low-down on with pictures, et al., this month. But, no luck, for I've been a very busy young man, so we'll beg your forgiveness this month (I've wanted to give you one each month) and these will come later.

Much Welding in New Grandstand

The new $200,000 grandstand at the Los Angeles County fair grounds at Pomona, Calif., involved the welding of 8,000 ft. of pipe used as guards, gates, partitions for box seats, etc. This pipe is of 1¾-in. diameter, and was all-welded by the electric-arc process. Shop welding was employed on practically 90% of the work, sections being welded together in specially made jigs which not only speeded production but also assured accuracy in the assembly for matching the inserts for the pipe in the concrete. The latter feature was accomplished with surprising accuracy, no misfits or trouble in this particular being experienced whatever in the entire job.

The original plans and specifications from the county engineers and officials awarding the contract, called for welded pipe, on account of the greater degree of uniformity and smooth, attractive appearance over that of threaded pipe with fittings. It was also found that the welded job was more economical, and, while perhaps not of so great importance in this case, the welded job affords greater strength and durability.

The welded sections, before being taken to the job for installation, were given a heavy coat of galvanizing, which gives the finished job an attractive and uniform appearance and makes it highly resistant against corrosion.

Arc welding was also used in the fabrication of about 3500 steel seat brackets, these being constructed of 2½x2½-in. angle iron. Each bracket has a 6-in. weld. A partial view of these brackets, installed with the bottoms and backs of the seats attached and ready for use, can be seen in the accompanying view which shows the welded piping.

Other features of this grandstand included welded window frames in the back of the structure, and welded doors and door frames, all of which required a great amount of welding. The contract for the job was let to the National Electric Welding Corp., of Huntington Park, Calif.

3500 Seat Brackets, Shown Above, and 8000 Feet of Pipe Were Welded for This Los Angeles Grandstand.

This Welder Loses His Pants

In a certain shop, where double-length pipe was being welded, the hose carrying oxygen and acetylene to the welding torches was lying along the floor. A leak developed in the gas hose right where a welder was working, according to a report appearing in a recent copy of a *News Letter* of the National Safety Council, Inc. The gas found its way up the welder's pants leg, and sufficient of it accumulated to be ignited, blowing his pants completely off of him. Though not injured in any way, the welder received the scare of his life. To eliminate this hazard, it was suggested that welders wear leggings or bicycle clips.

Building Up Bearings in Paper Mill

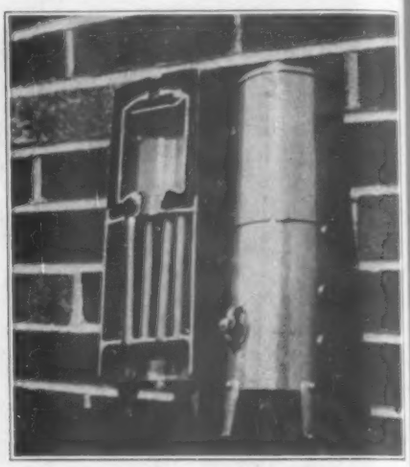
A continuous war against wear produced by friction is being waged by L. W. Pinyard, a welder with The Watervliet Paper Co. at Watervliet, Mich. This plant also uses the welding processes continually in making repairs and alterations.

Typical of some of the problems Mr. Pinyard has to solve with his gas and arc welding outfits is that involving the rapid wear of bearings in the coating machines. There are eight of these machines and each has a total of 8 half-round 4-in. bearings, which hold steel shafts carrying rolls of paper weighing from 800 to 1400 lb. apiece. These shafts revolve as the paper is unrolled and fed into the machine.

Originally these bearings were cast iron and would last only a month or so because of excessive wear. Mr. Pinyard now builds them up with Oxweld No. 25 M bronze, and so far they have been in service six months and show every indication of lasting another six months.

Welding Allows Reduction in Size of Boiler

An all-welded boiler, small but very efficient, is being manufactured by the Capitol City Boiler Co., Des Moines, Iowa, for pressing establishments and concerns where the steam demand is of a similar nature. Every seam is double welded, except that the tubes are rolled into the tube sheets. All joints are tested to 300 lb. pressure.



Welded Boiler and Sectional View.

It is claimed that this boiler has double the usual heating surface, double the working capacity between water fills, and double the weight (being made of extra-heavy material), yet it produces steam in about one-half the time required by the ordinary boiler constructed for this purpose. The average steaming time from cold water is 10 to 15 minutes.

This type of boiler would be useful to job welding shops for steaming containers preparatory to welding.

World-Wide Demand for New Welding Handbook

Evidence of unusual interest in arc welding throughout the world as well as in the United States is found in a recent announcement from The Lincoln Electric Company, Cleveland, Ohio, that orders were received from 13 different foreign countries in a single day for the book "Procedure Handbook of Arc Welding Design and Practice." The countries represented included the Canal Zone, Australia, India, Puerto Rico, Venezuela, Transvaal, South Africa, England, Norway, Sweden, Roumania, and other European countries.

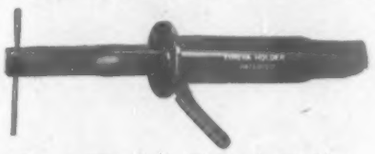
New Equipment

Small Electrode Holder Added to Eureka Line

A new light-weight electrode holder to be known as size 0 has been announced by The Fibre-Metal Products Co., Chester, Pa., manufacturers of the "Eureka Metallic Electrode Holder." The new size 0 is designed for light welding. The Fibre-Metal Products Co. also manufacture size 1 for medium welding and size 2 for heavy welding.

The new size 0 can be furnished with square or round heat shield. All three sizes are available in Type S (soldered connection) and Type R (quick removable connection).

The jaws on these holders are drop-forged from special steel and heat-treated



Size 0 "Eureka" Electrode Holder.

and can easily be replaced. They are brazed to the cable connection, thus providing a continuous electrical conductor from cable to electrode.

Ventilation is provided in the handle through a continuous air chamber running from front to back. The combined features of this electrode holder are said to produce an exceptionally cool and comfortable holder.

New Regulator Bodies Made of Forgings

The elimination of castings, with their nonuniformity and occasional porosity, has been successfully accomplished by the Harris Calorific Co., Cleveland, Ohio, in the manufacture of their pressure-reducing regulators. Bronze forgings are now substituted for the castings.

For several years this company has made efforts to use forgings for these parts, but until recently this could not be done without sacrificing an outstanding principle of design of these regulators. Every forging company consulted stated that the piece could not be forged on account of the projecting inlet arm in the body section which would prevent a withdrawal of the metal from the die. A redesign of the casting, eliminating the inlet arm, into which the valve nozzle is screwed, was out of the question since it was desirable to retain this arm as an integral part of the casting or forging.

This puzzle has now been solved by forging solid beneath the projecting arm and then removing the excess metal by a machine operation. The forged body is said to be meeting with great favor in the field, and is far more satisfactory from the standpoint of manufacturing.

Hard-Facing Materials Containing Metallic Boride

Colmonoy, Incorporated, of Los Nietos, Calif., was recently organized to handle hard-facing products, all of which have as their base Colmonoy crystals, a new metallic boride. All Colmonoy products have two outstanding features: a combined property of toughness and hardness, and a low specific gravity. For example, it is said that 1 lb. of Colmonoy inserts (hard sets) contains the same number of equal-sized pieces as 2½ lb. of the average tungsten carbide.

Colmonoy "Sweat-On" is recommended for use on parts subjected to extreme shock, abrasion and oxidation. It is applied either by the oxyacetylene or the electric method.

J. B. Reilly and R. C. Grinnell, of the Fluid Packed Pump Co., in Los Nietos, are associated with the new company, the sales manager of which is A. B. Leonard. These hard-facing products are described in the company's Bulletin 30.

Standard Steel Units for Reclaiming Plow Shares

Old plow shares can be reclaimed in an average time of 15 to 20 minutes by using "New Process" units, claims the New Process Plow Welding Co., Perry, Iowa. Three "New Process" units are required for each share. These units are of high-carbon steel to withstand wear and are correctly shaped and formed. Each of these units is shown in the illustration, together with a reclaimed share.

Units 1 and 2 are placed on each side of the old plow point, and then a high-carbon rod or hard-surfacing rod is used to lay a bead on the new point. The land-slide is then filled in. The cutting edge (unit No. 3) is then put in place and tack welded to the share for position, then welded by intermittent welds. These units can be welded with either the arc or the torch; but when the torch is used, bronze welding is recommended with the lowest amount of heat possible. All three units are of self-hardening steel so the heat does not draw the temper.

After the welded share has cooled, the land-slide is ground smooth and pointed, and the share point is ground to a sharp edge. The welds by which the cutting edge was attached to the plow share are ground smooth on the face of the share only.

The edges of units 1 and 2 farthest from the point are left unwelded so that when repointing becomes necessary all the operator needs to do is drive a cold-chisel between the points and the share and substitute a "New Process" repoint unit, which consists of units 1 and 2 and a small throat.

Magnetic Probing Device for Testing Welds

A method involving the use of a special "probing" device for testing welded seams has been developed by two German firms. The part to be examined is magnetized by permanent magnets. The "probing" device, connected to a special

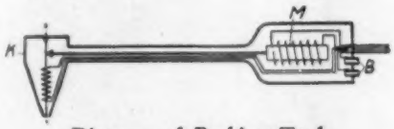
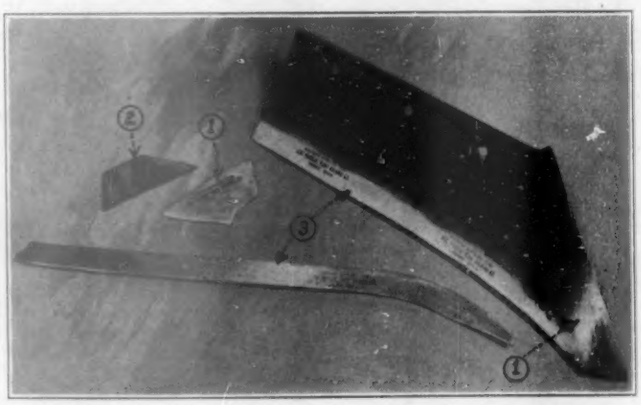


Diagram of Probing Tool.
(B, sockets for connecting headphones. K, head with search coil. M, magnet for vibrating search coil.)

amplifier located in a small portable desk, is moved across the weld at any point where the test is to be made. Defects in the weld make themselves evident by change in the volume and timbre of the



Plow Share Reclaimed by Welding Standard Steel Units to Old Share.

sound produced in a set of head phones connected to the device. After some practice, it is said, the operator can instantly determine the nature of the fault by recognizing its particular sound.

The outfit, which weighs 72½ lb. complete, can be operated from a 110 or 220-volt a.c. circuit.

A small search coil located in the head of the "probing" device is caused to vibrate at a certain frequency and small amplitude by means of an electromagnet in the handle of the device. When this search coil is introduced into a magnetic field, there is induced in it a voltage proportional to the alteration of the normal component of the field in the direction of the movement. This induced voltage is of constant value in a steadily altering field, but in the vicinity of a shrink hole, crack, bonding fault, or other defect, the variation of the magnetic field across the fault

Testing the Seams of a Tank.

is unsteady, causing a change in the induced voltage and also introducing harmonics.

The head of the "probing" device is adjustable so the direction of movement of the search coil can be changed relative to the magnet, making it possible to test simple butt and fillet seams as well as complicated junctions.

Welding Rod for White Metal

"Aladdin" rod, for the welding of white metal or die castings, has been put on the market by the Aladdin Rod & Flux Manufacturing Co., 225 Maryland Ave., Dayton, Ohio. This rod requires no flux, and it is claimed that the weld has a greater tensile strength than ordinary white metal. In making repairs with "Aladdin" rod, the broken edges are beveled as in ordinary welding, and the oxidized surface is removed by grinding, filing or other abrasive means. A No. 1 or No. 2 tip is used, with a slightly carbonizing flame.

Trade Literature

"Hard-Facing With Haynes Stellite Products" is the title of a 95-page booklet, replete with illustrations, issued by the Haynes Stellite Co., Kokomo, Ind. This booklet covers very thoroughly the field of application of hard-facing. It is divided into the following sections: The economies of hard-facing; hard-facing materials; agriculture; automotive; cement; brick; coke and gas; excavating; iron and steel; lumber and paper; machinery; mining; oil; power; beet-sugar, aluminum and glass industries; hard-facing procedure and costs; Haynes Stellite Co. products; and an index.

"Machine Gas Cutting" is the subject of a very attractive 92-page booklet issued by the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., which gives a conception of the important part that this process plays in industry. Airco cutting machines are illustrated and described, and the booklet shows their use in the production of many intricate as well as simple parts. Basic data are given for the calculation of costs. In addition to the cutting of low-carbon steels, information is also given on the application of gas cutting to high-carbon steels and alloy steels.

A. c. welding equipment and welding electrodes and accessories are listed in a pamphlet recently issued by the Electric Arc Cutting & Welding Co., 152 Jelliff Ave., Newark, N. J. Particular emphasis is laid on the combination of shielded arc with alternating current being used in the welding of the huge penstocks for Boulder Dam.

"Oxygen From the Air" is the title of a bulletin recently issued by the Superior Air Products Co., 132 Malvern St., Newark, N. J., describing "Supairco" industrial oxygen plants. A layout of a plant is shown, with flow diagrams of air, oxygen and nitrogen.

The designing of connecting plates for fixed-end connections of beams to columns is explained and sample calculations given in Plate 43 of the series of "Studies in Structural Arc Welding," issued by The Lincoln Electric Co., Cleveland, Ohio.

The properties and uses of tungsten carbide are discussed at length by Dr. Colin G. Fink in the Dec. 1933 issue of "Foote-Prints," published by the Foote Mineral Company, Inc., 16th and Summer Sts., Philadelphia, Pa.

"Ferroweld—an Electrode for Welding Cast Iron" is the subject of a leaflet issued by The Lincoln Electric Co., Cleveland, Ohio. Several interesting applications of this electrode are illustrated and described.

Commercial News

Michigan Jobber Adds "Torchweld" Line

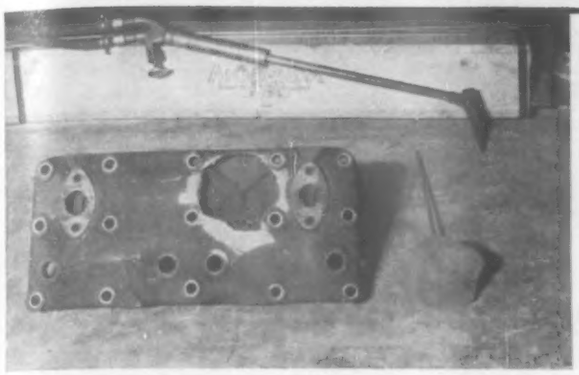
The Torchweld Equipment Co., Chicago, Ill., announce the appointment of the Fuller Supply Co., Inc., 230 Michigan St., N.W., Grand Rapids, Mich., as their distributor. The Fuller company will carry a complete line of Torchweld "Non-Flash" torches, regulators, accessories and supplies.

P. R. Mallory Makes Report on Sales

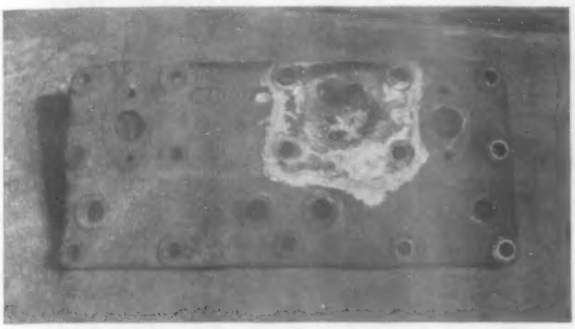
P. R. Mallory & Co., Indianapolis, Ind., reports approximate net profit for the year ending Dec. 31, 1933, at $26,000, compared with a net loss of $531,061 for 1932. Sales during the year increased 55.6% over 1932. The company increased the number of its employees from a low of 300 during 1932 to over 1900. An improved sales outlook for 1934 is indicated. Sales for January, 1934, were over 100% greater than in January, 1933.

Airco Takes Over Balance of Wilson Welder Stock

On Jan. 1st, the Air Reduction Co., Inc., exercised its option on the balance of the capital stock of the Wilson Welder & Metals Co., of North Bergen, N. J. Air Reduction thus becomes the first of the oxyacetylene welding companies to own a 100% interest in an electric-welding organization.



The cracked cylinder head and, in the background, a package of "good old Tobin Bronze" Welding Rods.



Repair-welded with Tobin Bronze, the casting was not distorted in any way. After slight grinding only, it was replaced on the motor.

Repair-welded *without risk of warping* with TOBIN BRONZE

AFTER freezing had cracked this cylinder head, repair-welding was decided upon as the most practical method of restoring the motor to service. But the choice of *what welding rod to use* was all-important. A rod requiring a preheating operation would have warped the casting and rendered it useless, or at least would have necessitated extensive machining.

So, Tobin Bronze . . . the original low melting point bronze rod . . . was selected. Extensive preheating was unnecessary, just enough heat being required to take the chill off the casting. This was furnished by the oxy-acetylene torch, and welding left the casting in such excellent condition that, after the rough edges of the weld area had been ground down, the head was replaced on the motor.

The consistently high quality which has always characterized Tobin Bronze explains its popularity with thousands of satisfied users who will accept no other brand. One of a line of seven Anaconda Copper Alloy Rods, Tobin Bronze is the most widely used . . . because of its widespread acceptance as the *ideal rod* for the general oxy-acetylene welding of cast and malleable iron.

All seven Anaconda Welding Rods are uniform in composition and of unvarying high quality because they are *made by Anaconda.* Back of each rod are long experience and technical knowledge gained in developing a complete line for low temperature welding, both gas and electric. Available through leading distributors . . . usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. Publication B-13, mailed on request.

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

for oxy-acetylene welding

Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1706° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

for arc welding

Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn.
Offices and Agencies in Principal Cities
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

ANACONDA
from mine to consumer

ANACONDA WELDING RODS

Revere Copper & Brass Announce Promotions

Announcement has been received from C. Donald Dallas, president of Revere Copper and Brass, Inc., of the appointment of J. A. Doucett as vice-president in charge of sales and of C. A. Macfie as general sales manager to succeed Mr. Doucett. In his new position, Mr. Doucett will give special attention to matters pertaining to the "NRA Code of Fair Competition of the Copper and Brass Mill Products Industry" as well as to company policies. Mr. Macfie, who was formerly assistant sales manager, will devote his time to general company sales activities.

J. B. Durkee has been appointed manager of the Houston, Texas, office of The A. M. Byers Co., Pittsburgh, Pa., according to an announcement from M. J. Czarniecki, general manager of sales. Mr. Durkee formerly represented the company in the Houston territory and more recently was stationed in Tulsa. He succeeds H. B. Weathersby, who died Dec. 19th from shock incurred as a result of an automobile accident.

The Gibbs Welding & Supply Co., Des Moines, Iowa, has been appointed distributor for the Westinghouse line of arc-welding equipment and supplies. This company was recently formed by H. I. Gibbs, job-welding shop proprietor known widely as "Gibbs, the Welder." The Gibbs company has appointed Stitzell Sales & Service, of Des Moines, as their sales agents.

Gideon W. Swan, after a continuous service of 48 years with the John A. Roebling's Sons Co. of New York, has retired from active service. Mr. Swan for the past quarter of a century represented the Roebling company in Buffalo, N. Y., with Wallace C. Palmer as his associate. Mr. Palmer will assume and carry on the work for the company in that district.

The Globe Machinery & Supply Co., Des Moines, Iowa, recently added the "Rego" line of gas-welding equipment manufactured by The Bastian-Blessing Co., of Chicago, and also the line of acetylene generators manufactured by The Sight Feed Generator Co., West Alexandria, Ohio.

The Omaha Welding Co., 1501 Jackson St., Omaha, Nebr., of which L. O. Schneiderwind is president, have added the "Amsco" line of manganese-steel welding rods manufactured by The American Manganese Steel Co., and the American Agile Corp. line of arc-welding wire.

The vacancy on the Board of Trustees of the Harris Calorific Co., Cleveland, Ohio, created by the death some time ago of E. H. Baker, Cleveland newspaper publisher, has been filled by the election to the Board of John Feighan, vice-president of The Cleveland Trust Co.

Harold B. Ressler, vice-president in charge of sales of Joseph T. Ryerson & Son, Inc., at Chicago, has taken charge of their Jersey City plant and will maintain a close contact with the other eastern Ryerson plants at Buffalo, Philadelphia and Boston.

The Wayne Welding & Supply Co., Fort Wayne, Ind., of which James McClure is proprietor, recently sold two 300-ampere Hobart gasoline-driven, trailer-type, pneumatic-tired arc-welding units to The Indiana Pipe Line Co., Laketon, Ind.

A patent law office has been opened at 140 S. Dearborn St., Chicago, by Morris Spector, formerly assistant examiner of patents in the U. S. Patent Office and more recently associated with the patent department of the Automatic Electric Co.

The C. E. Phillips Co., of Detroit and Chicago, have been appointed distributors for the Aladdin Rod & Flux Manufacturing Co., Dayton, Ohio, in the states of Iowa, Illinois, Indiana, Michigan, Ohio and Wisconsin.

The Welker Chemical Co., 1640 East 65th St., Cleveland, Ohio, have taken on the distribution of the special welding and brazing fluxes manufactured by the Pratt-Brayman Co., Bedford, Ohio.

A. B. Clark has been appointed general traffic manager of the operating companies of Union Carbide and Carbon Corp., succeeding the late Herbert Thompson.

The Grand Rapids Welding Supply Co., Grand Rapids, Mich., operated by the Macauley brothers, have changed the name of their company to Michigan Gases, Inc.

Notes From the Field

Job Welded 25 Years Ago Still in Service

Some of the old-timers will enjoy the account given by Frank Hastings, of Peterson, Iowa, of his first welding job, done about 25 years ago. Mr. Hastings was recounting his experiences before a small informal group at the recent welding conference at Iowa State College.

His first welding torch was a "Gem" torch, and those were the days when the welder had to make his own oxygen from a capsule which was placed in a generating tank, as tank oxygen was not available.

Mr. Hastings had his new welding outfit only a day or so, and had made no serious effort to master it, when a customer brought in five cast-iron line-shaft hangers that had broken. As he states it, with more nerve than brains he tackled the job, using "Twenty Mule Team" borax as a fluxing agent.

"I welded the first hanger and it really looked very good," said Mr. Hastings in his inimitable style, with some of his pet expressions deleted. "Then I put it on the floor to cool and had just started the second hanger when there was a loud 'ping.' I went over and looked at the one that I had just welded and it was broken again. I finished welding the second one and started on the third when the second one broke. Finally, after welding the third one, which also broke, I decided to get out the book of 'Instructions'—you know, those books that after one reading will make a man a salesman and two readings will make him a master welder—and I read through and found my mistake. So I started all over again, after preparing the breaks according to instructions. I welded all five and there were no 'pings' this time, and those five hangers are still in service today."

Incorrect Reports on Welder Sales

Items appearing in the December, 1933, issue of *The Welding Engineer* relating to the sale of new welders to Mitchum & Schaefer, Indianapolis; Coulter Boiler Machine Co., Muncie, Ind., and Northwest Engineering Works, Green Bay, Wis., were incorrect. These items were reported from independent sources, and therefore the companies named as well as the manufacturer of the welding machines are absolved from all blame in connection with the publishing of them.

Job-Shop Owner Hunts for Biggest Liar in County

A liars' contest is being successfully used as a publicity stunt by L. F. Spiese, proprietor of the Industrial Welding Works, Portland, Ind. Mr. Spiese pub-

HARRIS

SINGLE-STAGE REGULATORS

HARRIS

UNBELIEVABLE LOW PRICES

Quality Considered

For Immediate Acceptance

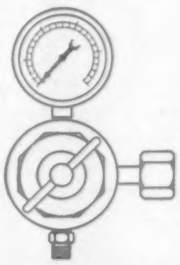
STANDARDIZE!

BUY NOW!

Use old gauges on new Regulators which can be purchased for approximately cost of repairing the old.

MODEL 440-W.

Oxygen Cutting Regulator for pipe line distribution Systems (also compressed air) where incoming pressure exceeds 100 lbs.



MODEL 440.

Single gauge type for Oxygen, Acetylene and other fuel gases where operating pressure does not exceed 50 lbs.

MODEL 441.

Double gauge type for Oxygen, Acetylene and other fuel gases where operating pressure does not exceed 50 lbs.

MODEL 442.

Double gauge type for Oxygen. Operating pressure to 125 lbs. Recommended for combination welding and cutting.

MODEL 443.

Double gauge type for Oxygen used in cutting operations. Delivers pressure up to 250 lbs.

Regulators (any model shown) without gauges, each	$6.75
Models 440 and 440-W, with single gauge, each	8.40
Model 441 Acetylene (specify cyl. connection) with 50 and 500-lb. gauges	9.90
Models 441, 442, 443 Oxygen, with 2 gauges, each	11.90

Catalogue, showing the most complete line of welding and cutting apparatus ever offered, free upon request.

THE HARRIS CALORIFIC COMPANY

2820 WASHINGTON AVENUE CLEVELAND, OHIO

DISTRIBUTORS IN ALL PRINCIPAL CITIES

lishes in his space in the *Jay County Citizen*, which is the local weekly newspaper, what he considers to be the biggest lie of the moment and asks the readers to try to tell a bigger and better one. The contest is creating a lot of interest. It has unearthed many who are bigger liars than he is, says Mr. Spiese, and has resulted in some valuable publicity for his shop.

Plans calling for a great amount of welding are under way by the Sinclair Refining Co., who will erect in the near future a 40,000-gallon natural-gasoline plant to be located in Gregg County, of the East Texas oil field. This company, which operates nine refineries throughout the United States, also recently completed extensive changes in its Fort Worth plant, in which welding was employed to a large extent.

The Oxley Welding Works, under the management of B. T. and C. Oxley, recently opened for business at 3356 E. Florence Ave., in Huntington Park, Calif. General job welding of all kinds will be handled, in addition to their specialty of the welding and repairing of laundry machinery and equipment. B. T. Oxley, one of the brothers, was formerly associated with the American Laundry Machinery Co.

The East Texas Refining Co., of Kilgore, Texas, is completing plans for the construction of a new oil-cracking unit in Henderson, Texas. The company's engineering department will be in charge of the welding and general construction work on this project, which is scheduled for completion by March 10th.

H. M. Priest, formerly of the American Bridge Co. in New York City, is now with the Railroad Research Bureau, a newly formed subsidiary of the United States Steel Corp. His address is 968 Frick Building Annex, Pittsburgh, Pa.

F. M. Farmer, vice-president of the Electrical Testing Laboratories, New York City, and director of the American Welding Society, has been elected vice-chairman of the Standards Council of the American Standards Association.

Wilfred White, of Ravenna, Ohio, a graduate of the Cleveland School of Welding, Cleveland, Ohio, recently opened the Wilcox Welding & Machine Shop in Ravenna, Ohio, after having gained considerable practical experience in several industrial plants in the state.

A 20-mile welded gas line is under construction in New Mexico, and will extend from the United States Potash Co.'s refinery at Loving, near Carlsbad, to the El Paso Natural Gas Co.'s main gas line in the southeast corner of Eddy County.

A contract for several miles of 3- and 3½-in. pipe, oxyacetylene welded, for the Crawford County Gas Co. at Flat Rock, Ill., was recently completed by the Industrial Welding Works, Portland, Ind.

Welding came in for an interesting discussion at the California State Boiler & Elevator Inspectors Convention, which was held at the Mayfair Hotel in Los Angeles, January 9th to 12th.

The Arco Welding Works, of 3815 S. Main St., Los Angeles, recently purchased a new Black & Decker grinder for special use in the work of welding car flywheel-starter teeth.

· CLASSIFIED ADS ·

Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

FOR SALE

Fly Ball Governors—Adapted to all makes of auto engines; belt driven, flat or V. Price, $6.50 prepaid. Satisfaction guaranteed. In ordering state style of belt. Wm. D. Alber, Beatrice, Nebr.

For Sale—Arc Welders, gasoline or electric driven. Spot Welders. Overhauled. Guaranteed. Attractively priced. Dealer correspondence invited. Electric Power Motors, Inc., A. F. Gross, Mgr., 1087 East 97th St., Cleveland, Ohio.

Bargains—Demonstrator Arc Welders. Gasoline, electric drive, belted, or coupled-together outfits. 30 days' trial. Easy terms, if desired. Write Ken's Welding Exchange, Box U-241, Troy, Ohio.

BUSINESS OPPORTUNITIES

Welding Sales Engineer—Wanted, for New York territory, sales engineer for arc-welding generators. Write, giving complete record, to The Welding Engineer, Box 131.

Responsible Dealers Wanted

Valuable territories are open to substantial, live-wire dealers. Particulars, including attractive discounts, explained upon request.

SMITH-WATERS WELDER

Competitive tests show that the Smith-Waters Welders can save as much as 50% in operating costs. The stable arc assures constant deposition of weld metal, and sound welds. No moving parts. Two-year guarantee.

Write for descriptive material.

David H. Smith & Sons, Inc.
5111 Second Ave.,
Brooklyn, N. Y.

POSITIONS WANTED

Acetylene Welder—Experienced in all branches of welding and supervising. Douglas Gibson, 2109 S. Essex St., Baltimore, Maryland.

Welding Engineer—Experienced with all types of welding and welding machines. At present employed but desires change. Address The Welding Engineer, Box 129.

Structural Engineer and Architect—13 years' experience in designing, detailing and handling welded and riveted structures. References. Fee or salary. Address The Welding Engineer, Box 134.

Welder—Fully experienced on chrome moly and high-carbon airplane tubing, also have welded oil-field tanks, both acetylene and electric. Present address in New Jersey, but will go anywhere. Address The Welding Engineer, Box 130.

Field Manager and Welder—At present with large manufacturer of field storage tanks. Available Mar. 1st. 16 years' experience in field erection of plate work, also time study and fabricating-shop work. References. Address The Welding Engineer, Box 132.

Welding Engineer—Experienced in the design and production of shielded-arc, coated and bare electrodes for manual and automatic use on direct or alternating current. Desires connection with progressive electrode manufacturer or welding concern as development engineer or field representative. Familiar with procedure control for boiler code and position welding. References. Free to travel. Address The Welding Engineer, Box 133.